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A DESPATCH from Des Moines, Iowa, under date of Friday last, informs us that Judge Conrad has decided that the ordinance passed some time ago by the Des Moines City Council, restricting the charge that the Capital City Gas Company might make for gas to $1.25 per 1,000 cubic feet, gross, is unreasonable and invalid. We applaud the Judge and congratulate the Company.

THE FAIR FUND.

The heated spell of the past week may have had something to do with the wilted appearance of the statement given to-day respecting current progress in the accumulation of the fund for the gas building at the World's Fair, but whether the weather had or had not any effect on the spirits of would-be subscribers, the fact stares us all in the face that only an additional amount of $200 has been pledged in the week ended Wednesday, June 15th. The Chicago Company's stolid and indifferent attitude is well maintained, and New York also manages to keep pretty well within its shell of composure, not to say apathy. It is very regrettable that this proposition has not received a heartier indorsement, and that the gentlemen who so earnestly and disinterestedly took the matter in hand have not been awarded that measure of assistance which their public spirit and progressiveness justly called for. In the meantime, we would repeat our suggestion of a week ago, that a day be fixed at which the subscription would be considered closed, and that the funds then in hand be used to the best possible advantage in carrying out the objects for which the Gas Industry Council was formed. We sincerely hope that this result will be reached, so that an entire and ignominious defeat be averted. The state of the subscription list to June 15th is as follows:

June 8.	Milwaukee Gas Stove Co., Milwaukee, Wis.	$100 00
	Increased Subscriptions.	
" 11.	Wilkes-Barre Gas Co., Wilkes-Barre, Pa.—From $100 to $200 ..... Increase	100 00
		$200 00
	Amount previously published	59,256 28
	Grand total (to June 15)	$59,456 28

BRIEFLY TOLD.

THE GUILD'S PLEASANT JUNE REUNION.—The Guild of Gas Managers' reunions are always notable for the hearty good fellowship that leavens the proceedings, and so it is that, whether the Secretary's call is for a stated gathering at the Boston headquarters or gives notice that the tryst is to be at or in one of the neighboring cities, everyone who can responds to the summons in the certainty that an enjoyable time is in store for him. The June meeting this year was "set" for Waltham, Mass., the incentive thereto being special invitations from the Waltham Gas Light Company and the Davis & Farnum Manufacturing Company. The appointed day was Saturday, the 11th inst., and at 1 P.M. thereof 30 gas men of "The Guild" were received by Col. C. F. Spaulding, Supt. of the Waltham Gas Company, and Mr. G. A. Stearns, its Treasurer and General Manager. The party repaired to the Gas Company's plant where the regular routine business was gone through, after which the works were inspected, with an ultimate verdict as to their completeness that ought to have been quite satisfactory to the Superintendent and the Secretary. This verdict was rendered in "open session" under one of the shade trees that ornament the Company's lawn

—think of it; a gas works with a lawn—and it is a lawn. Conveyances were then taken to carry the visitors to the handsome, spacious, and modernly equipped works of the Davis & Farnum Manufacturing Company. There the guests were received by Messrs. T. J. Davis, John R. Farnum, F. H. Brown and George Eccles, a quartet, it is needless to add, fully qualified to make wayfarers feel at home. The Company's works were examined with interest and profit, after which the inspectors found themselves confronted by tables covered with solid and other evidence of those things which go to make man feel that life is worth living. Those who were not present are respectfully referred to Leach, Stiness, "Frank" Richardson and "Fred." Davis for an account of what was said and done around and about the festive board. With appetites sated the visitors drove to the residence of Mr. Farnum, and the beauties of its surroundings were much admired. A trip to the Hotel Crescent concluded the set numbers of the outing-time—unless we include the fact that the party also "sat" for a photograph. At an early hour of the afternoon the return to Boston, via Newton, was made, and the excursion was happily terminated by an excellent supper at the United States Hotel, the proprietor of which, although he is not satisfied with the Addicks gas rate at Boston, did not have a word to say against the Guild. The day was a perfect one, both as to atmospheric conditions, and as to the measure of enjoyment that came to those who participated in the Guild's trip to Waltham.

THE SOCIETY OF GAS LIGHTING INVADES NEW HAVEN.—The Guild's jaunt to Waltham recalls the fact that almost a score of the members of the Society of Gas Lighting invaded Mr. F. C. Sherman's domain, at New Haven, on the morning of June 9th, where they were received very much in person by Mr. Sherman, whose capacity as a host is of the most persuasive sort. At the regular business meeting, which was held in Mr. Sherman's handsome and spacious office on the works, a paper, by Mr. Henry F. Allen, of this city, recounting his experience in "making straight" a refractory gasholder tank, was read and discussed, as were some figures respecting the state of the gas industry in Massachusetts. The outing features included a trip to Savin Rock, where a fish dinner of the most approved New England pattern was absorbed, as was a lunch at the gas works, the two being separated by an interval of time that served fully to illustrate Mr. Sherman's estimate of the capacity of gas men in general to absorb and assimilate rapidly the substantial things of this life. The day was favorable, the host was ubiquitous, and his guests were delighted and appreciative.

DEATH OF MR. CHOLLAR'S SON.—The fraternity will sympathize deeply with Mr. Byron E. Chollar, President of the Western Gas Association, in the sudden death of his oldest son, Byron C. Chollar. He died on the afternoon of Sunday, the 12th inst. Deceased, who was in his 19th year, was a lad of much promise, and his manner was indicative of the careful training bestowed upon him by his father, who watched the youngster's progress with very zealous care. Interment was made at Media, Kas.

AT the annual meeting of the Georgetown (D. C.) Gas Company the following officers were chosen: Directors, H. C. Winship, S. T. Brown, W. B. Orme, Thos. Knowles, M. J. Adler, John Marbury, Jr., and Geo. W. Cropley; President and Treasurer, John Leetch; Secretary, Thos. Knowles; Superintendent, R. L. Middleton.

NOTES.—The American Gas Company, in securing control of the gas works at New Rochelle, N.Y., has obtained a property that, apart from its own intrinsic value, which is certainly great, fits in nicely with its Mount Vernon purchase. In fact, there would be neither much trouble nor expense incurred in adapting the Mount Vernon works to answer the gas demands of both places.——The Boston Gas Light Company has awarded to Mr. Adam Weber the contract for the erection of 16 benches of 6's for the Wilkinson process, which the Company is about to install at its North End station.——At the annual meeting of the Paterson (N. J.) Gas Light Company, held on Wednesday, June 15th, the following Directors were chosen: John Reynolds, Wm. L. Williams, E. B. King, James Dunn, John S. Cooke, John H. Reynolds and Wm. H. Williams. The Directors subsequently elected the following officers: President and Treasurer, John Reynolds; Vice-President, Wm. L. Williams; Secretary, Robt. Schoonmaker.——Samuel L. Dearin, as Referee, advertises that, pursuant to a decree in foreclosure proceedings issued by the Supreme Court, the works and franchises of the Fishkill and Matteawan (N. Y.) Gas Light Company will be sold at auction, at 2 P.M., July 25.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONTINUED FROM PAGE 855.]

FIFTEENTH ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

HELD AT DETROIT, MICH., MAY 18, 19 AND 20, 1892.

SECOND DAY—MORNING SESSION.

The President announced that the next business would be the reading of the paper on

THE CONSTRUCTION AND OPERATION OF HALF-DEPTH REGENERATIVE FURNACES FOR FIRING WITH CHEAP COAL,

by Mr. W. H. Odiorne, of Springfield, Ills. The author read as follows:

Mr. President and Gentlemen of the Western Gas Association:—My experience with the construction and operation of semi-regenerative benches constructed for firing with cheap soft coal dates from the summer of 1889, when we contracted for and had constructed in our works, by the Parker-Russell Manufacturing Company, 3 benches, of 6 retorts each, known as the half-depth, semi-regenerative bench. They are built with large flues and fire box for the purpose of burning coal as a fuel. These benches consist of arches 12 feet high, 7 feet 8 inches wide, and 9 feet 4 inches deep, and are fitted with 6 retorts, each 15 by 26 inches, and 9 feet long. The furnace is constructed with primary and supplementary air flues, running from the front, back and then returning, with openings into the furnace from the return flue—thus allowing the air to become thoroughly heated before entering the furnace. The primary air flue enters below and the secondary above the fire, and they are fitted with dampers in front to adjust the amount of air to be admitted. The door in front is tight and held in place by a clamp and screw. Each bench is provided with an ashpan to hold water. The heat from the furnace, after passing up around the retorts, passes to the front into flues adjacent to and parallel with the air flues to the stack above the benches, each bench being provided with a separate stack. A pit is constructed in front of the benches, the floor of which is on a level with the ash pan, and is covered with an iron floor, with a trap door for entering it for clinkering, etc.

I commenced to fire two of these benches, December 6, 1889, by putting in the furnace a charge of hot coke drawn from a neighboring retort, and then, from time to time, adding some coal. The result was not what one would wish, as the soot began to gather, obstructing the draft, and in a short time the whole inside of the bench was a mass of soot. On the third day, not gaining any headway with the heat, I concluded to use coke again. This I did, and on the fifth day from starting had a fairly good heat and the soot had entirely disappeared. After running a few days with coke, and adjusting the air flues, I got a good white heat. I then commenced to fire with coal again, with much better results, but not satisfactory. I experimented with the air flues, and kept the fires well clinkered, but could only keep a red heat. Then I introduced a jet of steam directly under the grate bars, and this I found a great help, keeping the cinders from melting together and clinging to the sides of the furnace, being much easier to remove. It improved the heats some, but they were not what I wished them to be; and, after experimenting for about 5 weeks, I opened the supplementary air flues to their full extent, and found they did much better and continued to improve until we had a very satisfactory heat. The pit we found entirely too small—it extended only 6 feet back from the front of the benches, and gave the men no room to operate with suitable tools to remove the clinkers and take out the ashes. We also found it difficult to clean the air and smoke flues in so narrow a pit, showing the necessity for a wider one.

The other bench I fired with coke until I got a good white heat, and then used coal, experiencing no trouble. I continued to use coal from that time on almost entirely—occasionally using coke for a day or two at a time, when the wind was blowing from the south, as the smoke was very annoying to the residents living across the alley and just north of the retort house. The coke would keep a good heat, but the stokers preferred to use coal, as it required less attention. These benches I used continuously for 2 years and 1 month to 2 years and 4 months, when the last one was let down. During the time the benches were in use the charges averaged 325 pounds of coal to the retort, the length of time the charge remained in being 4 hours and 48 minutes. Each bench will use 1½ tons of coal per day for firing, or 7 bushels of coal for each ton of coal carbonized in retorts. The coal used in firing is mined within 1½ miles of the works, and is a fairly good steam coal.

Being so well pleased with the working of these benches and the results obtained, we decided to put in 6 more of the same size, with the express purpose of burning coal in the furnaces as fuel. Accordingly, in March, 1891, we contracted with the Laclede Firebrick & Manufacturing Company, of St. Louis, for 6 benches of 6 retorts each, known as the Mitchell bench; and to make room for them we at once commenced to tear out all the old benches, which were of 3 retorts each, plain, open setting, and a style that had been in use for the last 25 years, and without doubt had cost the Company a great deal of money, as they burned from one-half to two-thirds of all the coke produced to keep up the heat, and required much more labor to the retort than the benches now in use. The Mitchell bench is made with an arch 7 feet 8 inches wide by 9 feet 4 inches deep; the upright flues are 9 by 13 inches, and connect with a chimney 13 by 18 inches inside, extending through the roof. The arch is filled with 6 retorts, 15 by 26 inches and 9 feet deep, and are set with what is known as a self-supporting setting. The fire box is 4 feet deep, 18 inches wide, and extends back 4 feet at the top; the bottom being somewhat shorter, as the back end is made sloping. The furnace is fitted with 3 step grates or iron plates, which slope from the firing door to the grate-bars. On the top plate a small stream of water is admitted, and this drops from one plate to the other and then into the ashpan. By this the plates are kept cool, and some steam is generated, which serves to soften the clinkers. The furnace is equipped with primary and supplementary air flues. The smoke flues are connected from top to bottom with pipe or tile, which pass s down through the air flues, and by this means the air passing into the furnace becomes intensely heated before entering. The front of the furnace is closed with a tightly-fitting door, with clamp and screw to fasten it. Profiting by the experience in working the other benches, I built a pit in front 10 feet wide and 7 feet high in the clear. This goes down 2½ feet below the ashpan to the floor, which enables the workmen to clinker and remove the ashes much easier than if the floor was on a level with the ashpans. The pit is covered or floored with perforated cast iron plates, supported by railroad rails, and is connected with the coke shed by a tunnel running about 30 feet through the yard. In drawing the retorts the coke falls directly into the pit and is caught in iron barrows, and is then removed to the coke shed. On the 8th day of September we commenced to fire the first of these benches, being careful to use coke for firing until we had obtained a good white heat, then using coal with very satisfactory results. I soon found pea coal would burn as well as lump, and, being much cheaper, I used that for some time; but later on I found that coal dirt or slack would give just as good results with very little more labor—all it required being to stir it up with a bar two or three times between firing. This slack we now use entirely. It costs nothing but the hauling—1½ cents per bushel—and costs on an average 60 cents a day per bench. On the whole, I can say that we are well pleased with the results obtained with these benches, and I am sure they have resulted in a large saving to us since their introduction.

Discussion.

The President—Gentlemen, the paper is before you for discussion, and we would be glad to hear from a large number.

Mr. Dunbar—The results obtained by Mr. Odiorne in the consumption of coal are certainly wonderful. I desire to ask him if he is certain he is correct in his estimate that 1½ tons of slack coal, or pea coal, does the work. I also desire to know the yield per retort and per pound, and the kind of coal he uses.

Mr. Odiorne—We use slack coal, and have right along, and that is about an average. Some days when we charge heavier we burn probably a little more, and other days we burn less. The yield per retort is rather a difficult question to answer, inasmuch as sometimes we use half Pittsburgh coal and half native; the latter is a very inferior coal. Sometimes it is more than half one way, and less the other. However, when we are using Pittsburgh coal altogether we get about 8,000 to 9,000 feet, according to the size of the charges per retort. The yield per pound of Pittsburgh coal through the month is a little difficult to get at, inasmuch as we use cannel coal for an enricher, the cannel coal being put into separate retorts, and the gas, of course, goes altogether with the native coal, too. We have used at times all Pittsburgh coal and with very little cannel, and we then have a yield of 4.75 feet per pound. With our native coal the make runs about 3.25 feet per pound.

Mr. Tracy—As Mr. Odiorne states he has torn out one of those furnaces, I would like to find out how he found the furnaces. Those benches cost considerable money to put in—I am running one myself, but not long enough to tear it out—and I would like to find out if his furnace was fit to put in another setting without tearing it to pieces.

Mr. Odiorne—We had constructed at the same time one bench for firing with coke on the same side as this bench for firing with coal. The two south benches I tore out, and was surprised to find them in such good condition. The other two benches on the other or north side of the retort house, put in at the same time, I left in. I am going to fix up the front a little bit, as it is somewhat worn, and use them again. The retorts look very well, and I think they will run me, anyway through another winter.

Mr. Tracy—Do you think your furnaces will wear out several settings of retorts?

Mr. Odiorne—I do not know that I can say that. The furnaces are very good and the retorts are very good, and I am going to use the whole thing by patching up the front again.

Mr. Murdock—My experience with coal fired benches is a little older than that of Mr. Odiorne. In 1888, while Superintendent of the Huntsville (Ala.) works, I had put in, by the Laclede Fire Brick Company, two Mitchell benches of 5's, which were still running satisfactorily when I left there. In 1890 I had two Mitchell benches of 6's put in the Ottawa (Ills.) works, and have been running one or both constantly since then. I use nothing but slack coal for the furnaces and find that I can get any heat I want. Before working the Mitchell bench we could not get a better yield than about 3.20 cubic feet per pound of Streator (Ills.) coal, and our yield with the Mitchell bench, with the same coal, is about 4.10. Our retorts are 14 inches by 24 inches by 9 feet, and our highest make per bench in 24 hours was a little over 53,000 cubic feet, with Pittsburgh coal. I have a statement of this monthly make, showing results of one bench, to the 17th of May, and quantity of slack used in the furnace. We do not require more gas at present, or I could show better results, as I have made as high as 43,000 cubic feet with the same coal in 24 hours on this bench. The statement for the first 17 days of May is as follows:

Date.	Coal, Lbs.	Fuel Coal, Lbs.	Meter Statement.	Amount Gas Made.	Yield per Lb.
			2,910,300		
May 1.....	7,800	3,390	2,942,600	32,300	4.14
" 2.....	8,250	3,310	2,978,200	35,600	4.31
" 3.....	8,800	3,550	3,017,000	38,800	4.42
" 4 { Yough., / Streator,	3,100 / 6,250	3,530	3,056,200	39,200	4.10
" 5.....	8,800	3,690	3,094,300	38,100	4.53
" 6.....	9,350	3,275	3,132,400	38,100	4.07
" 6 { Yough., / Streator,	1,100 / 6,650	3,120	3,169,400	37,000	4.93
" 8.....	8,800	3,250	3,204,400	35,000	3.97
" 9.....	8,800	3,250	3,240,200	35,800	4.06
" 10.....	8,300	3,225	3,274,900	33,700	4.06
" 11.....	8,250	3,150	3,308,500	33,600	4.07
" 12.....	8,250	3,360	3,346,300	37,800	4.58
" 13.....	6,050	2,710	3,371,100	24,800	4.09
" 14.....	9,400	3,210	3,408,600	37,500	3.97
" 15.....	9,500	3,295	3,446,600	38,000	4.00
" 16.....	9,500	3,190	3,481,500	34,900	3.58
" 17.....	7,650	2,975	3,511,800	30,300	3.96

One of the two benches in Huntsville had been running 19 months when I left there. We run two benches during the winter, and let one down in the spring; and, so far as the setting is concerned, it is perfectly good. I may say that I think the setting is good for one or two more seasons. I started the bench on the 7th of March, 1891, and I have had no bother whatever with soot or the stopping of flues. I fired the first day and a half with coke, but from that on used coal. I fire with Streator slack—and it is nothing but slack. It costs 95 cents per ton.

Mr. Thompson—We are running at present 30 benches of 5's, fired by the Mitchell furnace, of the same construction described, and have contracted for 10 benches of 6's in addition, for which we are now tearing out the settings in the present arches and preparing for new settings. Our experience in the use of the coal for firing has been that, on the average, about 1,350 pounds of Illinois nut coal will be required to do the work of 1,000 pounds of Pittsburgh gas coke. The Illinois nut coal we get delivered at our works at $1.10 a ton, and the coke costs us 6½ cents per bushel of 36 pounds. A comparison on that basis would be $1.75 for the coke as against 75 cents for the coal. That is about an average comparison. We have had some difficulty with the stoppage of flues from soot, but it has not been a difficulty which has given us any considerable trouble to overcome. About once every week we will change for a few hours from coal to coke in our furnaces, and that of itself is sufficient to clear the flues from soot. We have also an attachment of steam pipes along the range of benches, with which, by the use of a long iron pipe, bent at the end, we can blow out the "organ pipes," as Mr. Dell has called them—the pipes which carry the waste gases—and

in that way keep them clear. No difficulty whatever is attendant upon the working of these benches, and their success is unquestionable.

Mr. Dunbar—I would like to ask Mr. Thompson what he usually obtains per retort, and whether his heat is as high with the slack coal as when working with coke.

Mr. Thompson—We are now employing the slack coal but are using nut coal, which is a first class steam coal. The heats are higher than they were when using free fire furnaces, but no higher than they would be with coke in the same furnace. Our retorts are very much smaller than those which Mr. Odiorne employs. Ours are 14 inches by 22 inches, by 8 feet 3 inches—quite small retorts. We charge from 290 to 300 pounds per retort. Our yield will vary from 5 feet to 5.20 feet. That is, we employ oil for enriching our gas. The yield per retort will figure from 8,000 to 9,000 feet per day, and sometimes a little higher.

Mr. Lynn—I have had some little experience with the Mitchell bench. We ran then at Evansville for almost two years. We obtained results which I suppose are about the best ever obtained by any Mitchell bench run at that time. We used on an average 2,500 pounds of coal per bench in 24 hours to do the work, carbonizing a weight of coal that required 60 bushels of coke in the ordinary bridge wall setting. This coke was worth 7 cents a bushel, representing a saving of $4.20. The coal that we used to fire the benches with was a native coal from Indiana, costing $1 a ton, laid down in the works. This would make the coal cost $1.25, showing a saving for the coal over the coke of $2.95 per diem. I carbonized 2,200 pounds of coal in six retorts every four hours. My retorts were extra large—they were 17 inches by 30 inches, by 10 feet long, in the clear, and my average yield with Youghiogheny coal was about 4.80. We never tried to get more than 4.80 out of that coal. We were using no enricher at that time, and when you get over 4.80 out of the coal you reduce your candle power accordingly.

Mr. Dunbar—I wish to ask Mr. Odiorne the appearance of his furnace when he is burning the slack. Does he have an intense heat in the furnace or simply a small heat and generate the carbonic oxide and burn that by his secondary air. When you open your fire door what is the appearance of the heat in the furnace?

Mr. Odiorne—If the fire is left in there for about an hour it is very hot.

Mr. Dunbar—I have reference to the pea coal itself. Does that get very hot.

Mr. Odiorne—It gets very hot at the back end of the furnace, but not in front.

Mr. Tracy—I have been using nut coal, and find I get a better heat with that at 90 cents a ton than I do from coke.

Mr. Thompson—Mr. Lynn speaks of 60 bushels of coke to do the work of 2,500 pounds of coal. How many pounds per bushel?

Mr. Lynn—Forty pounds.

Mr. Jenkins—You do not consume all your smoke?

Mr. Odiorne—That is a fact; no, sir.

Mr. Jenkins—Does it make a very bad nuisance to your neighbors, if the wind is in their direction?

Mr. Odiorne—Yes; the smoke rolls out in large volumes for 8 or 10 minutes after firing. From that on we get very little smoke.

Mr. Jenkins—Just at the first of the firing?

Mr. Odione—Yes.

Mr. Jenkins—I wonder if you could not consume your smoke? I do not get very cheap coal. Right opposite our works is a large boarding house sheltering about 40 persons, and if the smoke should happen to go over there I imagine I would hear from them.

Mr. Odiorne—It takes about 5 minutes to do our clinkering. We clinker, however, four times a day. We take out the ashes four times a day and do the clinkering without using supplementary bars. The coal cokes together and forms a bridge in the furnace, and we pull out all the old ashes and clinkers; it comes out easily.

Mr. Dunbar—Do you find the Mitchell bench to be adapted for the use of pea coal; that is, for firing.

Mr. Odiorne—I find very little difference in using pea coal or slack. This slack is very fine—as fine as wheat, or finer. In using either pea coal or nut coal, or even large coal, you can see very little difference. Our men would just as soon fire with slack as with anything else.

Mr. Lynn—This seems to be a paper gotten up for the Mitchell benches. Now, Mr. Odiorne has used the Parker-Russell half-depth regenerative bench, and I would like to ask him the comparative results obtained from the two furnaces. When he put in the Mitchell benches I gave him my experience and he gave me his, at that time, and I would like to have his experience in comparing the two benches.

Mr. Odiorne—I was so well pleased with the Parker-Russell benches that it was a matter of dollars and cents with me when I contracted for more benches, and have since contracted for four benches of the Parker-Russell pattern.

Mr. Gwynn—I would like to ask Mr. Odiorne how he clinkers when he uses coke for firing these benches.

Mr. Odiorne—Four times in 24 hours; the same time. We do not take all our fire out, you understand; we simply take all the ashes and loose clinkers out.

Mr. Tracy—I clinker every other day, but I do not put my men down in that pit only every other day. We shake it up and take the ashes out. I find no trouble on the days we do not touch it at all—just shake it up; and on those days we have the best heat and make the most gas. (Laughter.)

The President—Why don't you let it alone altogether?

Mr. Odiorne—It is a fact that the oftener you clinker, provided you remove a good mass of the fire, of course your heat goes down. In our method of clinkering I do it very quickly; as I say, it does not take more than 5 minutes. The furnace is up so high from the floor of the pit that a man can work very rapidly. It takes him a very short time, and consequently we do not lose the heat we would if we pulled everything out—both clinkers and heated fuel.

The President—I understand that Mr. Printz has had some experience in clinkering, and we would like to hear from him.

Mr. Printz—I cannot say that I have had very large experience in clinkering, for we only clinker once in about 4 to 6 months, and then we only clinker so as to not forget how. (Laughter.) I was going to ask Mr. Odiorne how often it is necessary to fire the furnaces with coal? And I want to ask the same question that was asked a few minutes ago in regard to the smoke nuisance. He says that the smoke rolls out considerably for a short time, and after that but little. What is this that he speaks of as not much? Is it just a little blue smoke that would not give any trouble, or would it be something that would be complained of on the part of the neighbors?

Mr. Odiorne—In answer to the smoke nuisance question, I will say that, in probably 15 or 20 minutes after firing, if you look up to the top of the stack you can see hardly anything coming out at all. You can see the heat radiating, but no smoke.

Mr. Printz—How often do you have to fire?

Mr. Odiorne—We fire once an hour. When we fire we just take a bar and run through the slack to loosen it up. If we want a little more heat, in burning off large charges, we shake that up two, or possibly three times between fires in order to let it burn a little more freely.

Mr. Dunbar—What are the dimensions of the furnace?

Mr. Odiorne—Four feet deep and 18 inches wide at the grate bars. It slopes back at the rear end.

Mr. Lynn—Are not your furnaces 36 inches wide only at the grate bars, and do they not slope after passing the grate bars?

Mr. Odiorne—Yes; it is 18 inches at the grate bars, and widens to 34 inches.

Mr. Gwynn—I would like to ask Mr. Odiorne if it is uncomfortably hot in clinkering with this furnace?

Mr. Odiorne—When we constructed these benches the men complained that they would be too hot, but they found that section to be one of the coolest places about the retort house, from the circulation of air about there. It is not at all hot, and they do not complain at all.

Mr. Gwynn—I think it would be well enough for the makers and constructors of these furnaces to adopt, if possible, some method of firing them, perhaps similar in construction to the Roney mechanical stokers, in order to get rid of this smoke.

Mr. Highlands—One matter that has not been touched upon very much in this discussion—this has been to me a most interesting discussion, and one of my reasons for coming was to listen to it—is in regard to the Streator coal. What do you do with the coke? Is it worth anything? How do you obtain the candle power; and what illuminating power does it give your gas?

Mr. Murdock—Our candle power was from 18 to 18½ candles.

Mr. Highlands—Is the Streator coke a hard, firm coke as it comes out?

Mr. Murdock—It is certainly quite as hard as that from Youghiogheny coal. It is good coal.

Mr. Highlands—Does it yield a coke good enough to fire the furnace with?

Mr. Murdock—Yes; we used it to fire with altogether before we put in the Mitchell furnace.

Mr. Highlands—Do you use any enricher?

Mr. Murdock—No; our Streator coal will make a richer gas than the Youghiogheny coal.

Mr. Highlands—A year ago I abandoned the use of coal gas and put

in a water gas process, but since the increase in price of hard coal, we little fellows in the West feel like turning to something else, in case of an emergency at least ; and for that reason I hope this discussion will not close until the matter is a little better ventilated.

Mr. Thompson—The gentleman from Ottawa, Ills., said he made something over 4.20 per pound.

Mr. Murdock—Yes.

Mr. Thompson—Of 18½ candles ?

Mr. Murdock—I might better say 17 to 18½ candles.

Mr. Thompson—By what photometer was that measured ?

Mr. Murdock—By the Jones' jet. (Laughter.)

The President—I used some Streator coal, and on a very careful test found the gas to be fully 18-candle power. The yield was small ; I think, about 4.50 or 4.60.

Mr. Thompson—In handling our furnaces, while we clinker twice in 24 hours, we remove the ashes and generally slightly shake up or clean the fire six times altogether. Our retort house is of the stage floor pattern, and the furnaces are handled from a staging or carriage running a height of some 8 feet above the cellar floor, or some 6 feet beneath the stage floor—the level of the charging floor. One man will attend to 10 furnaces, doing the work of clinkering and adjusting the water and air ports, when necessary, the firing, however, being done from above. We fire about once an hour, as Mr. Odiorne does.

Mr. Doan—As I understood you, Mr. President, you stated a moment ago that you had used the Streator coal. What was your yield per pound ?

The President—I don't remember exactly, but think it was about 4.50.

Mr. Doan—That is certainly remarkable.

The President—It was supposed to be the best quality of Streator coal. The coke we considered poor ; so poor, in fact, that we would not think of using any more of the coal.

Mr. Gwynn—Mr. Odiorne speaks of enriching with cannel coal. Did you ever try to burn the cannel coal coke in your furnace ?

Mr. Odiorne—Yes; I have burned it in the furnace—sometimes when we ran short of slack we used it, and it went very well. The most of the time we used the coke from the cannel coal under our boilers, and the men liked to use it. It makes a slow fire.

Mr. Gwynn—Did you notice that it made any increase in the clinkers when you used it the furnace ?

Mr. Odiorne—Yes ; it did.

The President—I would answer the gentleman's question a little further concerning the coke. We could not keep up the heat by carbonizing the Streator coal with its own coke. We had to charge, in a portion of our works, Pennsylvania coal in order to get coke to keep up the heats to the point of burning off the Streator coal.

Mr. Dell—There has been a good deal said about this Mitchell bench, and I hope you will pardon me for making a remark in connection with it. This firing with coal seems to be looked upon as a new thing. It is not new, however, for Mr. Mitchell has used it for about 10 years at his works.

Mr. Lansden—I move a vote of thanks to Mr. Odiorne for his excellent paper.

The President—I think Mr. Odiorne may consider himself duly thanked without putting the question. We will now listen to the paper by Mr. A. E. Forstall, of Newark, N. J., on

THE ORIGIN OF COAL AND PETROLEUM.

As Mr. Forstall was not able to be with us Mr. Ramsdell has very kindly consented to read the paper. Mr. Ramsdell read as follows :

The average gas engineer finds his time so fully taken up by the routine of his position, or by investigations bearing directly upon the improvement of the processes with which he had to deal, that he has little leisure for original research in outside fields. When, therefore, the wisdom of the "powers that be" in the Western Association assigns such a subject as this for a paper, there surely can be no expectation of the development of any new and startling facts or theories. The idea must rather be to obtain a summary of facts and theories already known to and advanced by geologists, with a brief, succinct, statement of the arguments for and against these various beliefs. It is from this standpoint that what follows has been written.

Geology is, from the nature of things, an indefinite science, in so far as it deals with the earlier periods of the earth's existence. Studying the effects produced by natural forces at the present day, it reasons that in the past similar effects argue the operation of the same forces. But even the record of these effects as contained in the portions of the earth's crust explored by the geologist is very incomplete, many gaps being left to be filled in by deduction, always liable to error. Any moment may bring forth some new fact, upsetting preconceived ideas and compelling a remodelling of theories. However, the theory as to the formation of coal now generally held is apparently as firmly founded as any geological speculation, and will probably never have to be materially altered. That in regard to petroleum is not so certain, but accounting satisfactorily for all the facts as known, must be accepted until some new and irreconcilable discovery is made.

Let us take up coal first. Almost all the coal known to and worked by man dates from the Carboniferous Age division of the Paleozoic Period, taking its name from the extent of its coal formations, and itself capable of sub-division into three minor periods ; the Sub-Carboniferous, the Carboniferous proper and the Permian. It is in the measures of the second of these subdivisions that coal is principally found, in seams varying from a fraction of an inch to 40 or 50 feet in thickness. Under each coal seam is a bed of fire-clay ; above it a covering of black bituminous slate. A pure, simple seam is rarely more that 8 to 10 feet thick, the mammoth seams being formed by the running together of several seams through the thinning out of the intermediate strata, which are still to be found in very thin layers through these seams. Between the seams, with their accompanying clays and black slate, are layers of sand and lime stones. A section through the coal-measures shows a number of seams of coal, in some cases as many as 50 or 60, of various thicknesses and degress of purity, separated from each other by intervening strata of sandstone and limestone. The vegetable origin of coal is no longer considered doubtful, and quoting from Le Conte's "Elements of Geology," we have the following as the principal evidence upon which is based the present scientific unanimity of opinion on the subject :

"*First.*—The remains of an extinct vegetation are found in abundance in immediate connection with the coal seams, stumps and roots in the under clay and leaves and stems in the black slate in contact with the seam, and even imbedded in the seam itself.

"*Second.*—These vegetable remains are not only associated with the seam, but have often themselves become coal, though still retaining their original form and structure.

"*Third.*—Not only these easily recognizable imbedded fragments, but the imbedding substance also, the whole coal seam, even the most structureless portions and the hardest varieties, such as anthracite, when carefully prepared in a suitable manner and examined with the microscope, show vegetable cells with characteristic markings.

"*Fourth.*—A perfect gradation may be traced from wood or peat on the one hand, through brown coal, lignite and bituminous coal, to the most structureless anthracite and graphite on the other, showing that these are all different terms of the same series. In chemical composition, too, the same series may be traced.

"*Fifth.*—The best and most structureless peat, by hydraulic pressure, may be made into a substance having many of the qualties and uses of coal."

These are, in brief, the main reasons for the belief in the vegetable origin of coal. Working on this hypothesis, how can we account for the different varieties of coal, classified according to their elementary composition ; that is, according to the relative amounts of carbon, hydrogen and oxygen contained in them, these being the three elements forming a pure coal ? The substance that makes up the mass of the cell membranes of all plants is called Cellulose, and has a composition denoted by the chemical formula, $C_{18}H_{30}O_{15}$, signifying that each molecule is formed of 18 atoms of carbon, 30 atoms of hydrogen and 15 atoms of oxygen. When vegetable matter is protected from contact with air, as it may be by being covered with water, mud, or a growth of fresh vegetation above it, a slow decomposition takes place by mutual reactions among its own elements. Carbon unites with hydrogen to form marsh gas, CH_4 ; also with oxygen, forming carbonic acid, CO_2, while hydrogen and oxygen unite, producing water, H_2O. These reactions are proved to take place by the continual giving off of marsh gas and carbonic acid from the coal in mines, these two gases being the fire-damp and choke-damp, so dreaded by miners. Analysis also shows that the bubbles, which rise to the surface when we stir up the decaying vegetable matter at the bottom of a pond, are composed of these gases.

Starting now with 2 molecules of Cellulose, or $C_{36}H_{60}O_{30}$, by subtracting 9 molecules of CO_2, 3 of CH_4 and 11 of H_2O, we have left $C_{24}H_{26}O$—the formula for an average cannel coal. In the same way we obtain $C_{36}H_{20}O_2$—the formula for average bituminous coal—by the substraction of 7 molecules of CO_{21}, 3 of CH_4, and 14 of H_2O ; and finally, if we deduct 10 CO_{21}, 10 CH_4 and 10 H_2O, we have left C_8, which is pure carbon or graphite. Thus reactions known to occur are shown to be capable of producing coal from vegetable matter, another strong argument in favor of this theory.

It is almost certain that bituminous coal has been formed in the manner indicated from the original vegetable matter, without the aid of heat, the strata found with it showing no sings of metamorphism. The extreme varieties of coal, anthracite and graphite, are always found, however, associated with metamorphic rocks, so that it is almost equally certain that in their case heat has played a part in the complete expulsion of the hydrogen and oxygen. Such heat need not be extreme, a temperature of 300° to 400° F. being sufficient to produce all the metamorphic effects found in the anthracite regions.

The origin of the coal thus determined, how can its accumulation in its present form of numerous seams throughout the coal-measures be accounted for? This accumulation certainly took place in the presence of water. In no other way can the preservation of the original organic matter which would have decayed if left exposed to the atmosphere, the presence of interstratified layers of clay, sand and limestone, or the stratification of the coal itself, be explained. Besides the plants found in connection with the coal seams are such as grow in moist ground. Opinion, however, is divided as to whether the growth and deposition took place on the same spot, or whether the latter occurred at a distance from the original home of the plants, being brought about by the formation at the mouths of rivers of the so-called "rafts," an example of which is found at the mouth of the Red River. The theory of growth *in situ* seems most probable, agreeing better with the facts of the comparative freedom of coal from ash, which is intermixed inorganic matter; the existence on top of the seams of numerous perfect specimens of the most delicate parts of plants, and the number of stumps found apparently in the exact condition and position in which they grew in the underclay.

The study of the strata of the coal-measures seems, also, to indicate that the forests, from which the larger coal beds have been formed, grew at the mouths of rivers, on low lands more or less marshy and subject to overflows from the rivers, with occasionally an incursion of the sea due to a gradual subsidence of the continent. The land area of the earth bearing then a much smaller proportion to the water than it does at the present day, the air was more saturated with moisture and consequently the climate was much warmer and more equable; water vapor, from its property of allowing luminous heat rays to pass almost untouched, while almost completely absorbing the dark rays radiated back from the earth, being one of the potent agents in storing up in the earth the heat coming from the sun. These conditions of constant moist warmth, coupled with the presence of an excess of carbonic acid in the atmosphere, produced a most luxuriant forest growth, continuing for years and forming a constantly thickening deposit of vegetable matter. Now and then an overflow of the river covered this deposit with a thin layer of sand and mud, on top of which a new seam began to form. At longer intervals an inrush of the sea put an end to vegetation and formed a stratum of limestone. But gradually the sediment brought down by the rivers built up on the sea bottom new deltas on which a new growth began and the process was repeated.

Thus, by the alternate growth and submergence of vast forests, were the materials destined to produce these deposits of incalculable value formed and stored under the conditions necessary for their future transformation. Slowly, during the thousands of years of the carboniferous period, did the energy of the sun transform the carbonic acid of the atmosphere into solid carbon; still more slowly through the succeeding eras came the changes bringing this carbon to its present form, and now, after ages of preparation, man is "unbottling the sunshine" modifying the rigors of winter and turning night into day with the rays apparently lost millions of years ago.

Turning to petroleum, we find opinion much more divided, and no such general knowledge of the subject as to warrant implicit belief in any particular theory. The various theories may be divided into two classes; those asserting a derivation from the chemical reactions of minerals or inorganic matter, and those claiming an organic origin through the decomposition of vegetable or animal matter.

The theories of Berthelot or Mendeljeff are leading examples of the first group. According to the former, petroleum is formed by the action of water, carrying carbonic acid in solution, upon alkali metals existing in a free state and at a high temperature in the center of the earth, he having pointed out the reactions that would take place resulting in the formation of hydrocarbon compounds.

Mendeljeff's theory supposes the existence in the interior of the earth of metallic iron and metallic carbides at a high temperature, which, by contact with water, would generate metallic oxides and hydrocarbon compounds.

Both theories consider the production of petroleum as continuous, the vapors rising as they are formed and condensing to liquids in the porous strata of the oil-fields, thus making the supply inexhaustible as long as the necessary minerals and water exist.

But these theories, though chemically perfect, are not generally accepted by geologists, since they do not accord with geological facts, which point more to the organic origin of petroleum; that is, to its derivation from the decomposition of vegetable or animal matter originally contained in the rocks in which it is found, or in closely associated strata. As we saw in considering coal, the decay of vegetation at ordinary temperatures, when taking place out of contact with air, produces marsh gas. Peat bogs yield inflammable gases, and sometimes also members of the bitumen series closely allied to petroleum and asphalt, thus showing the decomposition of organic matter to be competent to produce petroleum.

There are two views as to this method of decomposition: One, that it is a primary decomposition of organic matter in or associated with the strata where the oil is found—the production, therefore, being *in situ*; the other, that a primary decomposition of the organic matter to hydrocarbon compounds first takes place, from which compounds oil and gas are derived by distillation and carried by hydrostatic pressure to the overlying porous strata, which act as reservoirs.

The chief exponent of the theory of primary decomposition is Prof. T. S. Hunt, who holds that petroleum is principally derived from animal remains contained in limestone rocks, though he admits a few cases of vegetable origin.

The theory of distillation is most fully stated by S. F. Peckham, in the report on petroleum contained in the tenth volume of the "Special Reports of the U. S. Census of 1880." He considers that petroleum was formed by distillation principally from beds of shale containing fucoid plants and animal remains, with limestone as a minor source, basing this view upon the variations in composition of petroleum found in different portions of the same field, which he thinks can only be accounted for upon the theory of fractional distillation. In the case of the Pennsylvania oil field, the oil is derived principally from vegetable remains in rocks far below the present level of oil occurrence, the heat for its distillation having been supplied by the causes that resulted in the upheaval of the Appalachian mountain system, and the evidences of this heat are to be found deep down beneath the unaltered rocks in which the petroleum is now stored. Peckham also considers the occurrence of large veins of solid bitumen in fissures and metamorphic rocks as a further proof of the fact of distillation.

In Vol. VI. of the "Reports of the Geological Survey of Ohio," Prof. Edward Orton, the State Geologist, discusses the subject of the origin of petroleum quite extensively, reviewing the various theories given above, indicating their weak points, and stating his own views, derived from a special study of the Ohio fields in connection with a general study of the whole subject. Admitting the great want of definite information that prevents any theory from being accepted as perfect, he inclines toward the idea of primary decomposition as the great factor in the production of petroleum, a decomposition including both vegetable and animal matter, according to location. Thus the large amounts of nitrogen and sulphur in the Lima and California oils—the unstable character of the latter—and their presence in limestones filled with animal remains, are strong proofs of an animal origin. These limestone oils are dark and heavy, with a rank odor, and are easily distinguished from the oils of a probable vegetable origin, such as the Pennsylvania type, coming from bituminous shales and found in sandstones.

As an argument against the theory of distillation, Prof. Orton cites the fact that the study of the rocks underlying the Ohio oil fields, by means of borings carried 1,800 feet below the oil-bearing strata, shows no signs of metamorphism, which, as this depth is below the only known sources of oil supply of the Pennsylvania type, would seem to condemn the idea of distillation. In favor of the theory of primary decomposition, he notes the fact that, at the presesnt day, in Trinidad, beds of slate formed in comparatively recent times beneath the sea, but now raised above its level and containing abundant vegetable remains, are yielding petroleum in large quantities by direct decomposition of vegetable tissues, this petroleum passing into asphalt as a result of exposure to the atmosphere. But if the action took place where the petroleum could be stored out of contact with the air it would remain as petroleum. This is what has happened in the oil fields. A tropical climate seems necessary for this action.

Applying the views derived from the foregoing facts to explain the origin of the oil of Eastern Ohio and Pennsylvania, the following theory is worked out: These fields were the site of a tropical sea, upon the floor of which the shales constituting the chief source of the oil were accumulated. The rivers emptying into this sea laid down sedimentary deposits of clay and sand, with occasional gravel bars. In the sea itself

was a vast development of marine vegetation. Some of the especially abundant plants had very resinous spores and spore cases, which were set free in enormous quantities, and, in connection with other portions of these and similar plants, were carried to the bottom in a macerated condition, there to pass through the coaly transformation, resulting in the structureless carbonaceous matter that constantly characterizes black shales, and that can still be made to yield by destructive distillation members of the bitumen series. The shales, thus slowly accummulated at the bottom of this gulf, must have behaved as similar shales do now, petroleum and bitumen being formed as in the case of the Trinidad shales. The petroleum was absorbed by the particles of clay in contact with it, or if formed in the water, was caught by floating particles (clay possessing the property of absorbing oils in a marked degree), being carried by them to the floor of the sea as the sediment deposited. This process continued until the materials were exhausted, producing a shale much richer in petroleum than any portion of it is at the present time. Over this was laid a bed of porous sandstone, saturated with seawater and roofed in by a very fine-grained shale. Then, by a slow system of exchange between sandstone and shale, the oil reached its final reservoir.

Prof. Orton claims that this theory finds more support in the present processes of nature than that of distillation, as we see the bitumen series forming to-day by the apparent primary decomposition of organic matter under normal conditions, while on the other hand we do not find this series in any case open to observation and measurement as a result of secondary decomposition, unless the comparatively high temperatures of destructive distillation are reached. Still he admits that every theory in regard to petroleum is merely provisional, and none can be accepted as final. He summarizes his views as follows :

First.—Petroleum is derived from organic matter.

Second.—It is more largely derived from vegetable than from animal matter.

Third.—The oils of the Pennsylvania type result from the organic matter of bituminous shales ; that is, they are of vegetable origin.

Fourth.—The oils of the Canada or Lima type are derived from the organic matter in limestones, and are, therefore, probably of animal origin.

Fifth.—Oil was produced at normal rock temperatures ; that of the Ohio field at any rate certainly not being the result of a destructive distillation of bituminous shales.

Sixth.—The stock in the rocks is practically complete, for though the production is still going on the rate is so slow as to make no appreciable increase in the amount already produced, in any ordinary space of time.

Prof. Orton's views have been given thus fully because he is the latest writer on the subject, and his ideas, being based upon a broad study of the whole field, are probably the most reliable. But according to his own statement the final word cannot yet be said as to the origin of petroleum.

From what precedes, it is seen that though coal and petroleum are of similar, they are not of the *same* origin; are not necessarily correlative; nor is petroleum a product of the transformation of vegetable matter into coal. The difference in the product of the two operations, one being a solid in all stages of its transformation, while the other is a very volatile liquid, may account for the greater certainty with which the record of the first can be traced through all its successive steps, and the almost total absence of record in the case of the second. As more is learned, however, by the development of new oil territory, and a more systematic study of the facts revealed by the drill, the theories of the origin of petroleum may be put upon as firm a basis as those relating to coal. Until then the gas man must accept the dicta of geological oracles, and keep at the, to him, more important task of working out the best method for the destruction of petroleum, without being absolutely certain as to its origin.

Discussion.

The President—Gentlemen, this is certainly not only a very interesting paper but a very ably written one as well—one that we will heartily thank Mr. Forstall for. I do not think it is a paper that will require very much discussion, but if any one desires to make any remarks upon it, we will be glad to hear them.

Mr. Clark—There is an evident typographical error on page 3, line 26. It reads as follows : "In the same way we obtain C_{34}, H_{20}, O_9—the formula for average bituminous coal—by the subtraction of 7 molecules CO_{21}, 3 of CH_4 and 14 of H_2O." While sitting here I have worked out this formula, not thinking that CO_{21} is what was meant by Mr. Forstall, and find that CO_2, which I supposed would fit the case, does. It is a mistake of the typographer.

Mr. Harper—I noticed the mistake that Mr. Clark has called attention to. On pages 2 and 7, I think that possibly the word slate is used instead of the word shale.

Mr. Clark—I think it would be dangerous to change that to shale. Shale might fit the case, but so does slate. I would like to ask some more learned gentleman if a bituminous shale is not a slate.

Mr. Somerville—No.

Mr. Egner—Mr. Forstall has acquitted himself very creditably with this subject, and I will move that a vote of thanks be tendered him.

Mr. Somerville—I do not see the need of cutting things off so quickly as that. I was about to say something in regard to the end of his description of the coal formation. It is as follows : "Still more slowly through the succeeding eras came the changes bringing this carbon to its present form, and now, after ages of preparation, man is unbottling the sunshine, modifying the rigors of winter, and turning night into day with the rays apparently lost millions of years ago." I think he might have added that we are also engaged in taking the nitrogen which entered into the plant life at that period out in the form of ammonia and putting it back to the ground again and so performing a beautiful function, which I think was lost sight of here. And I was simply going to say something, which I think Mr. Egner had in his mind, that this is a paper that does our young friend Mr. Forstall a great deal of credit. It is a paper that will be invaluable for reference.

Mr. Egner—I would also add, Mr. President, that it is a lesson for the members of this Association. It shows what one can do when a subject is assigned to him. The subject of the paper is one which probably might not have been exactly the thing to bring before this Association, and I should think, from the opening and closing lines of the paper, that Mr. Forstall is of the same opinion. A more practical subject would have elicited more criticism and discussion, but he has certainly given us a most admirable paper.

The President—I will say that when the paper committee considered this matter they deemed it would be impossible to find any one who would be willing to write on that subject, and I think we should be exceptionally thankful to Mr. Forstall for his efforts. A motion has been made that a vote of thanks be tendered him. I now put it to the convention. (The motion was unanimously carried.) One matter needs attention this morning before we adjourn. The report of the Committee on the President's Address carries with it a recommendation that a change be made in the by-laws. The by-laws at present read : "Any proposition to alter or repeal an existing by-law shall be presented in writing on the first day of an annual meeting, seconded by not less than three members, shall lie over until the next day and be read again, and if approved by two thirds of all the members present, shall become a part of these by-laws." I will say that on account of the report of this Committee not coming in yesterday, it was impossible to read it at that time, but unless objection is made it will be considered that this amendment was read yesterday, and we will now read it a second time for your acceptance. Of course, it is understood that only active members can vote on this question, and it will require a two-thirds vote. The Secretary will please read it.

The Secretary—The following amendment is respectfully submitted for the consideration of the members of this Association as supplementary to Section I. of Article VII. of our by-laws : "When, in the judgment of a majority of the Board of Directors, it shall be deemed advisable to change the place or date of meeting, or both, as designated by the Association at its last annual meeting, they shall have power to make such change or changes."

Mr. Lansden moved the adoption of the amendment, which motion was seconded by Messrs. Gwynn, Ramsdell and Egner.

Mr. Humphreys—I move we suspend the by-law, Sec. I. of Art XIII., for the consideration of the question therein referred to. (Seconded and adopted.)

The motion to adopt the amendment was then agreed to.

The Association then adjourned until 1:30 o'clock, P.M.

SECOND DAY—AFTERNOON SESSION.

The President announced that the business in order was the reading of the paper, by Mr. B. E. Chollar, of St. Louis, Mo., entitled

PRACTICAL PHOTOMETRY SIMPLIFIED FOR DAILY USE.

Year by year, slowly but surely, with the growing wealth of the people, the continually increasing supply of surplus capital, and the consequent sharpening competition in all lines of business, involving large sums of money, the margin of profit in the gas making industry is gradually diminishing. Gas to-day is sold in many places for less than the cost of making it 20 years ago, and the day is not far distant when a limit will be reached that will permit no further reduction in price.

If, when that day comes, an end to the demand for cheaper gas would come with it, the conditions might be endurable; but such will not be the case, the people of 20 years hence will be like the people of to day—the clamor for cheaper lights will be as loud and as persistent as ever, and the purveyors of gas will be constrained to choose between the closest profit, or some means of increasing the efficiency of their product, that shall make it of more value to their patrons.

In electric lighting, increase of efficiency means increase in cost of lamps; the greater the economy of energy, the shorter the life of the lamp. In gas lighting increase of efficiency means no loss, but only care and attention with comparatively slight expense.

The common gas tips of to day will be the popular burners for many years to come, and if a reasonable amount of thorough and systematic attention to the duty performed by them can be made to effect a large increase in the light they develop, the result will be a probability of holding the present and increasing future business, which is equivalent to an increase of profit. If, without cost to our consumers, we can enhance the value of the services that our goods render to them, they will by that extent be more likely to remain with us. It matters not to them whether such result be effected by reduction in price, improvement in quality, or a means of using the same quality to better advantage.

The latter plan affords a good field for profitable work by gas companies, for the reason that much can be done at little cost. This is easy to understand when we consider that with common coal gas the lighting service is all obtained from about 6 per cent. of its volume; hence, a destruction of 2 of these parts or only 2 per cent. of the whole volume, by reason of unsuitable or badly adjusted burners, will effect a loss of one third or more of the available light. So freely can the light-yielding compounds be consumed without furnishing their due proportion of light, it is by no means an extravagant statement to say that the average gas burner develops less than two-thirds the light that may be expected of it.

The following are notes of experiments made with common lava tip, E. H. burners. The gas was 18 candle power, and the standard a Sugg London D Argand with 24 holes, regulated to consume exactly 5 feet per hour. The standard burner was in good order and the chimney clean. The lava tips were all new, clean and in perfect condition. The efficiency of the standard burner was considered to be 100; the efficiency of the other was computed in terms more or less than 100, according as they developed more or less light, cost for cost, than the standard:

	Feet per Hour.	Efficiency.		Feet per Hour.	Efficiency.
A No. 1 tip....	4.8	62	A No. 6 tip.....	14.2	94
ditto.....	2.9	51½	ditto.....	9.2	102
ditto.....	2.5	49	ditto.....	5.8	100
ditto.....	1.7	47	ditto.....	4.8	100
A No. 2 tip.....	10.0	66	ditto.....	2.8	84
ditto.....	9.3	69	A No. 7 tip.....	16.0	96
ditto.....	5.8	75	ditto.....	10.0	101
ditto.....	3.6	83	ditto.....	6.5	102
ditto.....	2.3	81	ditto.....	7.0	103
A No. 3 tip.....	10.2	71	ditto.....	4.0	94
ditto.....	7.6	75	A No. 8 tip.....	16.6	98
ditto.....	5.0	94	ditto.....	11.4	103½
ditto.....	3.6	89	ditto.....	8.0	106
ditto.....	3.0	89	ditto.....	4.8	100
ditto.....	2.3	80	A No. 10 tip....	17.4	95
A No. 4 tip.....	11.0	93	ditto.....	12.8	104
ditto.....	6.7	92½	ditto.....	9.4	100
ditto.....	5.0	94	ditto.....	6.2	96
ditto.....	3.0	91	No. 30 "Standard".....	18.2	103
ditto.....	2.2	87	ditto.....	13.0	108
A No. 5 tip.....	13.2	86	ditto.....	8.7	104½
ditto.....	7.4	96	ditto.....	7.5	104
ditto.....	5.1	99			
litto.....	3.3	90			

Tips nominally of the same size and capacity are not always equally well suited to the same gas. For instance: One particular No. 10 tip, at 11.2 feet per hour, gave 160 per cent. more light than the standard argand at 5 feet, or an efficiency of 116. The same burner at 11.4 feet gave 200 per cent. more light than the standard, or an efficiency of 132; while at 11.6 feet it developed 220 per cent. more, or an efficiency of 132. In the latter case the gas consumed with a burner that cost 3 cents was worth one-third more to the consumer than when burned with the expensive argand. With old and dirty burners, especially when inclosed in dusty globes, we will see by the following that the unnecessary loss of light is enormous; they are experiments made for consumers who complained of the quality of the gas.

A tip burning 3.7 feet per hour gave an efficiency of 38, or reduced the value of 18-candle gas to 6.8 candles.

A No. 3 tip at 4.5 feet gave an efficiency of 41, or reduced the gas to 7.4 candles.

A tip consuming 7.2 feet per hour and developing an efficiency of 33, was replaced by another that gave 70 per cent. more light at 7 feet per hour.

A No. 3 tip in an opal globe gave an efficiency of only 13—the illuminating power of the 18-candle gas was reduced to less than 2½ candles.

Another, a No. 4 tip in an opal globe, gave an efficiency of only 20. The consumer was reducing the candle power to $3\frac{1}{10}$, and paying a dollar for the same light that he might have had for 20 cents.

Gas consumers purchase gas for the light it affords. The cost of a required amount of lighting is what they look at, but they give little attention to economical methods of using the article; nor can they reasonably be expected to do so. As long as gas supplies them with what they consider to be the most satisfactory light for their requirements, just so long will they remain patrons of gas companies; but when some other light is brought to their notice that strikes them more favorably, they will adopt it, to the exclusion of gas.

To develop the best light comes within the field of the gas company as much as to furnish the best quality of gas at the lowest price. We can talk about "educating" our customers to take care of their burners and fixtures, but it will do no good—they will not do it. A consumer's interest in the question is only individual, while the gas company's interest is the aggregate of the consumers' interests, and whatever effective work is to be done in this line must be done by the gas companies.

The requirements for a systematic development of the efficiency of gas for lighting purposes are few; a specially constructed photometer and a good deal of work with it being the chief requisites.

Heretofore the use of the photometer has been principally to determine the quality of the gas as an article of manufacture. The proposed use of the instrument is an additional and a different one. The gas is taken as we find it, and the object is to see that it is used to the best advantage with such burners as are in common use.

With the ordinary form of the photometer the middle of the bar represents unity—one candle—or an equality of lights. For efficiency purposes the same point represents zero—equality—or no difference in the strength of the lights. One scale indicates the strength of the stronger light in terms of the weaker; the other, the per centum of excess in strength of the larger light over the smaller. Both scales can be graduated on the bar and the same instrument used for both purposes—in fact the divisions are the same for both scales—the numbering only being different.

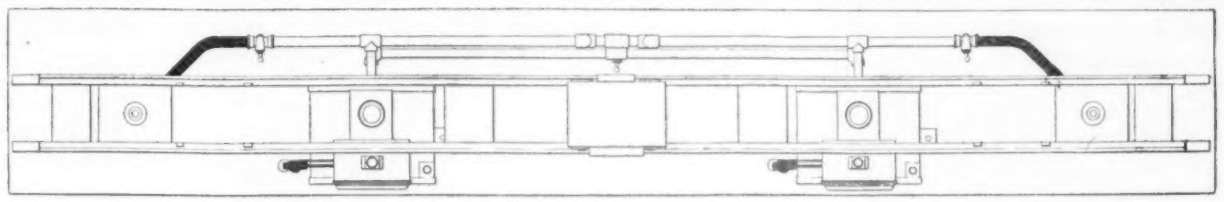
Two meters are employed, one for each light; they are connected with pipes and a specially designed valve in such a way that both can be started and stopped at exactly the same time without disturbing either light. The pillars for the lights are connected with the meters by means of flexible tubing, and are so arranged that the lights can be raised or lowered vertically. When candles are used for a standard they are placed in a socket attached to the top of one of the burner pillars. With these few exceptions, the instrument is precisely like an ordinary bar photometer. For ordinary use a distance of two meters between the lights answers a very good purpose.

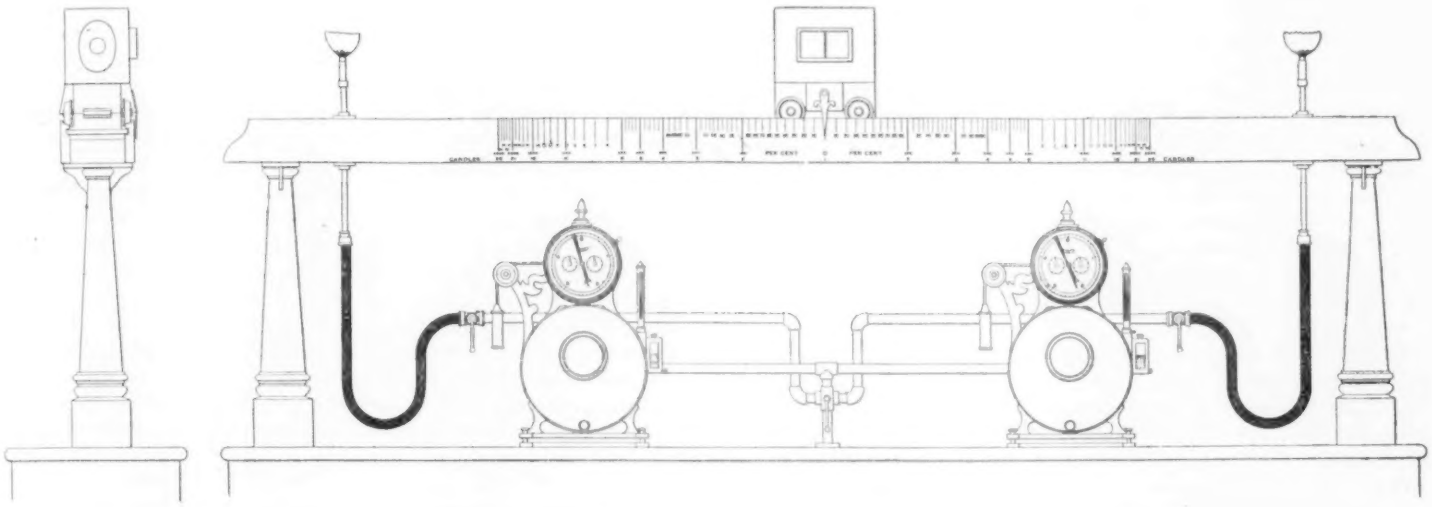
To one who desires to make his own photometer, the graduating of an accurate scale upon the bar might appear to be a difficult matter. This difficulty disappears when we remember that the 4-candle mark will be exactly one-third the distance from the middle of the bar to the center line of either light; the 9-candle mark one-half the distance; the 16-candle mark three-fifths; the 25-candle mark two thirds, and the 49-candle mark three-fourths of the same distance.

These points being marked on the bar beforehand, the scale can be drawn on paper and the usual tracing and blue prints made. By taking care that the above noted division marks coincide exactly with the corresponding marks on the bar, the blue print can be pasted to the bar quite as accurately as if the scale were engraved on the bar itself.

The following table has been computed for a bar two meters long, and up to 50 candle. The measurements are taken from the middle of the bar and are given in millimeters. In using the table it must be remembered that the 1-candle mark indicates no difference in the strength of the lights; 2-candle equals 100 per cent. more light; 3 candle 200 per cent. more, etc.

(See table on opposite page.)





Candles.	Per Cent. More Light.	Distance from Middle, in Millimeters	Candles.	Per Cent. More Light.	Distance from Middle, in Millimeters	Candles.	Per Cent. More Light.	Distance from Middle, in Millimeters
1....	0	0	3...	240	297	14..	1,300	578
	2	5		250	304		1,350	584
	4	10		260	310	15..	1,400	590
	6	15		270	316		1,450	595
	8	20		280	322	16..	1,500	600
	10	25		290	328		1,550	605
	12	29	4...	300	334	17 .	1,600	610
	14	33		310	339		1,650	615
	16	37		320	344	18..	1,700	619
	18	41		330	349		1,750	623
	20	45		340	354	19..	1,800	627
	25	55		350	359		1,850	631
	30	65		360	364	20 .	1,900	635
	35	75		370	369		1,950	639
	40	84		380	374	21..	2,000	643
	45	93		390	378		2,050	646
	50	101	5...	400	382	22..	2,100	649
	55	109		420	390		2,150	652
	60	117		440	398	23..	2,200	655
	65	125		460	406		2,250	658
	70	132		480	413	24..	2,300	661
	75	139	6...	500	420		2,350	664
	80	146		520	427	25..	2,400	667
	85	153		540	434		2,450	670
	90	159		560	440	26..	.....	673
	95	165		580	446	27..	.....	678
2....	100	171	7...	600	452	28..	.....	683
	105	177		620	457	29..	.....	687
	110	183		640	462	30..	.....	691
	115	189		660	467	31..	.....	695
	120	195		680	472	32..	.....	699
	125	200	8...	700	477	33..	.....	703
	130	205		725	483	34..	.....	707
	135	210		750	489	35..	.....	711
	140	215		775	495	36..	.....	715
	145	220	9...	800	500	37..	.....	718
	150	225		825	505	38..	.....	721
	155	230		850	510	39..	.....	724
	160	235		875	515	40..	.....	727
	165	240	10...	900	520	41..	.....	730
	170	244		925	525	42..	.....	733
	175	248		950	529	43..	.....	736
	180	252		975	533	44..	.....	739
	185	256	11...	1,000	537	45..	.....	742
	190	260		1,050	545	46..	.....	744
	195	264	12...	1,100	552	47..	.....	746
3....	200	268		1,150	559	48..	.....	748
	210	276	13...	1,200	564	49..	.....	750
	220	283		1,250	572	50..	.....	752
	230	290						

The table was calculated by the following formula ; those who desire to compute a scale for themselves will find it convenient :

Let B = the length of the bar between lights, x = the distance of the candle from the disc, and n = the number of candles for that point : n times x^2 is supposed to be equal to the square of the rest of the bar; or,

$$n\,x^2 = (B-x)^2.$$

Extracting square root $x\,\sqrt{n} = B - x$,

$$x\,(\sqrt{n}+1) = B,$$

$$x = \frac{B}{\sqrt{n}+1}.$$

In other words, the distance between the lights divided by one, plus the square root of the number of candles, will give the distance from the candle to the point representing that number of candles.

Many years ago some writer on gas, by a very tedious process, worked out a very clumsy expression for the above, and later writers have all accepted it as the correct thing. The above will not be found in the books. It is correct, however, and is probably the simplest possible formula for calculating a photometer bar, and is, moreover, original with the Western Gas Association. The photometer once completed, there is hardly a limit to the instruction and profit to be gained by its use. The meters indicate the gas consumed, and the bar the light given by each burner ; a short double computation will give the value of either light in terms of the other.

In order, however, to reduce the work to a minimum and do away with any calculating whatever, an extensive table has been constructed, which solves the arithmetical part of the problems by simple inspection. For instance, suppose the instrument shows one light, at 5.2 feet per hour, to give 10 per cent. more light than another one at 6 feet per hour. A simple inspection of the table will show that the efficiency of the former is 27 per cent. better than that of the latter. The experiments are so easily and quickly performed that they never become tiresome or tedious, and practice with the instrument becomes so fascinating that the appearance of the whilom arch fiend of a gas office—the kicking consumer—is hailed with delight, as affording fresh material for instructive and interesting investigation ; while the operator, in his supreme satisfaction, will regard his photometer as "a thing of beauty" and "a joy forever."

Discussion.

The President—Gentlemen, the paper is before you for discussion.

Mr. Bredel—I understand Mr. Chollar has had some experience about the right way of fixing the candles, by weight or by height of flame. I wish he would give us his experience.

Mr. Chollar—I worked for many years with a photometer by weighing the candles, and got very unsatisfactory results, for the reasons

shown in this paper. The experiments there show that the light corresponds in no way with the quantity of gas consumed. With a candle we have the changing condition of the wick turning over and around and in all shapes. It is almost impossible, with a gas burner burning at standard rate and with a steady light, to get two readings on the box that are alike, and it shows plainly that a candle used in this way is not correct. A number of years ago some German or French Institution spent a great deal of time on the matter, and the result is that in Germany and France, when candles are used, the practice is to use the candle at a standard height of flame. If you use the candle in that way there is no need of the balance of the photometer at all—you have no use for it. The English candles will burn exactly 2 grains a minute when the flame is between 46 and 47 millimeters. Forty-six millimeters is $1\frac{13}{16}$ inches. You have a pair of dividers and you set your dividers at $1\frac{3}{4}$ inches apart, and before you take the reading on the box you measure the height of the flame from the bottom of it to the top. If it is not $1\frac{3}{4}$ inches do not take any reading. If it is too high clip the wick, and if it is too low let it go up. You always have a nice, clean flame, and then by putting the photometer under the standard burner it will make the consumption of the standard burner always alike, so that you can go through the whole experiment and the reading on the sight-box will be the same all through. In fact, one reading is just as good as a dozen. It simplifies the operation of the photometer. The principal use of this photometer is not for that purpose, but for comparing the efficiency of burners in practice.

Mr. Somerville—In measuring the flame, what do you do to keep the draught from it?

Mr. Chollar—Don't have any draught. If there is any draught there you cannot measure the flame. You must have everything quiet, you must not breathe upon the flame. You will find that in practice.

Mr. Somerville—I thought perhaps you took some special precautions.

Mr. Chollar—You can take any you please. I am careful not to breathe upon the flame. When I take the height of a flame I put a pair of smoked glasses on, so that it will not affect my eyes for reading the sight-box.

Mr. Somerville—I have often noticed in the photometer room the flame will move a little in spite of you.

Mr. Chollar—You must not take a reading except the flame is at that height, and you will always have the same reading through the experiment. That is only a secondary use of this photometer, but the main use of it is for the efficiency of burners. I can show some remarkable work done with it.

Mr. Highlands—This is a very practical paper, and it opens up another question, regardless of the photometer, which is as to the comparative merit or demerits of the ordinary jet which we are compelled to use in burning different quantities of gas. The question arises to me in this way, by what method are we going to control the consumption of gas in those burners? What is the easiest and simplest method for giving each one of those burners the necessary amount of gas?

Mr. Chollar—In my own opinion the best way would be to make a department for that special business; for gas consumers will not attend to it.

Mr. Somerville—I have been much struck with the point that Mr. Highlands has brought out here, and which Mr. Chollar so clearly demonstrates, the necessity of education to the gas consumer, who will not come and be educated himself; for that is a fact. Many years ago I suppose some few here will remember that I had the honor of reading a paper*, before the American Gas Light Association, on the subject of, "The Defects of the Gas Globe and Holder." I then took the stand that Mr. Chollar is taking to-day, that the gas companies ought by all means to control the gas at the burners, that it is their business to do so. I showed or tried to show them the amount of light that was wasted, as Mr. Chollar has done to-day, and as our customers are doing all over our districts. The objection I remember then was the gas companies *could not* take the responsibility. Such was the objection urged against the paper—that the gas companies should not because they could not take the responsibility of controlling, or having anything to do with the gas fittings. I often thought since then, and think so now, that we owe a debt of gratitune to the electric light companies, in that they have shown the gas companies how to do business in this respect. They are not afraid of taking any responsibility. Just suppose for a moment, if we can suppose such a thing, of an electric light company trying to do business on the line that a great many of us are doing. We will suppose that an electric light company has started in, has its machinery and dynamos all up and the office open. A man comes to the office and says he wants the electric light. "Well," says the gentlemen at the desk, "is your house wired?" The man answers, "No." "Oh, then," remarks the electrician "you must get your house fitted, and as soon as you get that done we will turn on the electric light." "Well," utters the man, "will you do it for me; I don't know anything about it," and in reply thereto is told, "No, get a fitter to do that, that is not our business, sir; our business is to supply electricity; you have to find a fitter and when the house is completed you come and speak to us and we will see about putting in the electric light." Just suppose for a moment that that was the case; how would electric companies have succeeded—as they are doing to-day? We must, as Mr. Chollar says, educate the people how to burn our gas. Nothing is more annoying to us than to see our 20-candle gas brought down to 6 or 7-candles, by our consumers using dirty, unsuitable burners, as has been so fully shown by his experiments here to-day. For some time past the Company I represent has employed a man whose sole duty is to go from store to store, with his pockets full of burners, and a pair of plyers. He takes off all poor burners and replaces them with burners best suited to give the most light from the gas. That man fully earns his wages, both in the increased consumption resulting from his work and the satisfaction he is giving our customers (at this point Mr. Clark lit one of the gas burners in the convention room which gave a very poor light.)

Mr. Clark—There you can see the point. (Laughter and applause.)

Mr. Somerville—That is a sufficient demonstration. I wish before sitting down to express my personal gratification for this paper. Mr Chollar desires great credit. It is a beautiful instrument, and I think every gas company ought to have one.

Mr. Chollar—The experiments with this photometer are not difficult at all. One minute would show just how bad a burner the one in the room here is, in figures.

Mr. Somerville—Undoubtedly.

Mr. Chollar—You invite the consumer to come to your office and see for himself. You not only tell him he has got a bad burner, but also you show him just how bad it is, and give him the figures.

Mr. Jenkins—What is the efficiency of that light up there?

Mr. Chollar—I should judge about two. (Laughter.)

Mr. Tracy—One point made by Mr. Somerville I do not think we all could afford to follow, and that is to employ a man to do as is done at Indianapolis. Is it not possible that the consumer might claim that that man was sent around with a view to increasing the Company's gas bills?

Mr. W. L. Brown—I represent a small Company, and, therefore, it is not for me to attempt to teach you; but I will state that for the last four years we have been doing just what Mr. Somerville advises. We have a man who does nothing but attend to the burners. On the least complaint we send him to the houses or stores of the consumers.

Mr. Murdock—I represent a small Company, whose method is to have little cards printed, which are distributed to every consumer in the city. On the card we stated that the Gas Company had burners and tips at the office, which it would send out and put on at its own cost, on notification by the consumers. The card also stated the amount of gas lost by imperfect burners. I found the practice had a very good effect.

Mr. Highlands—It occurs to me that we have not struck the meat of this question yet. My friend Somerville compares the method of procedure of electric light companies with that of gas companies. I was unfortunately manager of an electric light plant as well as a gas plant. In handling electric lights we have our meters, so that we constantly know the strength of the current that is going out over our lines—at least, we know what efficiency each of our lamps should give us; and, with the exception of incandescent lights, our customer is the constant and immediate judge as to whether his lamp is giving good service or not, but in the case of gas burners my friends may have customers who report when the burners are out of order, but I have never had one. I have found gas tips so adjusted that with a tip capable of passing 12 or 15 feet an hour I was positive of getting only 8 or 9 feet an hour through it. Until we arrive at some such method as that, I do not see how we are going to get the efficiency of the burners.

Mr. Chollar—You can get the efficiency when the burners burn the proper amount of gas, a point that has to be taken care of by the gas companies themselves. The consumer never will object at all to your giving him more light for less money; but they will not complain until they get very bad light, and then they will "kick." You take the average burners right through a street and they will develop not much over two-thirds of the light they ought to. It is business that the gas companies will have to care for themselves.

Mr. Odiorne—I would like to ask if Mr. Chollar took the case of check burners.

* See JOURNAL, Dec. 3, 1877, p. 223.

Mr. Chollar—Check burners, or anything else to make the rate right. If the pressure is too high use a check burner; if it is not high enough clean the pipe so that you get plenty of pressure. Check burners as a general rule are the best.

Mr. Lansden—A great many burners are made nowadays that are not check burners—they are governor burners. It is utterly impossible for any gas company to supply the same pressure at the various points through the district. The only thing to do is to put on governor burners.

Mr. Chollar—I have tried a great many governor burners, and found out that, when the tip is suited to the governor and the governor is clean, it is all right; but the check burner, which answers all purposes, only costs 2 cents. Suppose you get 3 inches of pressure in the main; it may vary from 1 inch to 4. Now, a check burner can be put on there and regulate it. Have a proper tip, so that the pressure can go down to 1 or up to 4 without affecting the efficiency to any great extent. It is not necessary to have the rate exactly uniform. A burner suited to burn 6 feet could burn 5 feet or 7 feet, and it would give more light at 7 than at 5; but the main point of efficiency is that a burner which is all right at the present time, in six months from now will not be in good order. The burners ought all to be examined periodically, and tests recorded showing how bad they were. Not only that, but the Company should grease the stopcocks and give them a general overhauling. In keeping them in order the Company will be well paid for the work.

Mr. Jenkins—In your No. 2 tip, burning under, I should judge, 1 inch pressure, you say that at 2.3 feet per hour you have an efficiency of 81. The more you increase the pressure the less efficiency you have. Where you are burning 10 feet you are only getting an efficiency of 66. In the 11-foot burner, burning 5 feet, you have an efficiency of 94. We want a burner that will give the same efficiency all the way through,

Mr. Chollar—You cannot do that. You can adjust a burner so that with the fluctuating pressure in the mains the efficiency will vary only a little.

Mr. Jenkins—If you double your pressure you increase the flow.

Mr. Chollar—Oh, no; four times the pressure to double the flow.

Mr. Jenkins—Double the pressure and you increase it 25 per cent.

Mr. Chollar—The flow is in proportion to the square root of the pressure. That law does not hold good with burners at low pressure.

Mr. Jenkins—If you put a governor on you won't have your variation; you will control the variation in the main.

Mr. Chollar—As I understand, your check is simply two little holes. It might be a burner with a screw in it. I have a little instrument that I brought along to show the difficulty of taking the pressure at the tip, but I did not bring it to the hall. In order to get the pressure at the tip you put the pressure gauge between the check and the tip. You are using a check burner, for instance, with 4 inches pressure in the main. You will perhaps have only 5-tenths or 6-tenths above the check; at the tip the pressure varies only slightly.

Mr. Jenkins—You have a tip that burns more than your check will carry through.

Mr. Chollar—I do not have any particular check or tip at all.

Mr. Jenkins—Don't you have your tip to burn more than the check would ordinarily carry through?

Mr. Chollar—Generally.

Mr. Jenkins—Don't you have to do that always; for instance, what good would your check be—say, that your check would pass 6 feet and your tip would only burn 2 feet, what good would your check be?

Mr. Chollar—Well, if the check don't "check" it is of no use.

Mr. Lansden—That question is just what I want to get at. I claim that if a check burner will only give the same amount of gas under the same pressure, it does not check. I put a pressure of 1 inch on a burner with a 6-foot tip. If I put a pressure of 3 inches on that same burner tip I will not get as much light on the photometer as I had with the low pressure, because I increased the pressure between the check and the tip, which ought to be, I think, from 3-tenths to 4-tenths.

Mr. Chollar—That is what the photometer finds out.

Mr. Lansden—The governor is the only thing that will answer that purpose.

Mr. Chollar—My experience is that the governor burners are not worth the money; the check, properly adjusted, answers the purpose.

Mr. Lansden—A great many governor burners were made in the last 30 years. I do not even know the name of the burner we use, although we have 10,000 or 12,000 of them in use. I have tested them and know that between 1 and 4 inches they burn the same amount of gas.

Mr. Chollar—What is the gain by that?

Mr. Lansden—I claim that a single check with 1 or 2 holes in it will not give a varying pressure to the tip.

Mr. Egner—I think the discussion is rather going away from the photometer, the subject of Mr. Chollar's paper, to burners. Now, when I first saw this photometer of Mr. Chollar's (I think it was about 2 years ago) I was very much impressed with it, and thought it would be of a great deal of use to the members of this Association, not only to those who use the Jones jet photometer, but also to others who do not. If one desires to compare burners, it is an excellent thing. It is not only used to measure the candle power of the gas, but to compare the same gas with different burners. Mr. Chollar could make a test in about one minute. He could take one burner off, the same gas is burning on the bar on both columns of the photometer, and could take the burner tip off, and put another on, and test the tip about as quickly as I am telling you about it. I thought it was such a useful apparatus, or would be, if used in the proper way, that I made it the subject of a portion of my address last year at Louisville, and recommended that Mr. Chollar be invited to give us a paper on the subject at this meeting, and I think really that we ought to stick to the subject and not wander off so much on the merits of governor and check burners.

Mr. Chollar—That is the object of the photometer, to find out—that is what the photometer is for.

Mr. Egner—That is what I understood.

Mr. Chollar—In answer to Mr. Lansden, as to the desirability of having a burner burn an exact rate, it would be very well, and very desirable for that matter, but not particularly so. There is no particular object in having a burner that will burn exactly the same rate when there is only a slight variation, but a rheometer under a standard burner is invaluable because it will maintain your standard burner absolutely at a constant rate, and will not let it vary at all. What is the difference whether the burner burns 5.4 feet or 6 feet, provided we get the light. The consumer gets his money's worth, when the burners are clean.

On motion of Mr. Ramsdell, a vote of thanks was tendered to Mr. Chollar.

[To be continued.]

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Toledo (O.) Gas Light and Coke Company the following officers were elected: Directors, S. M. Young, H. S. Walbridge, C. R. Faben, Jr., John Cummings, A. L. Backus and H. S. Young; President, S. M. Young; Vice-President, H. S. Walbridge; Superintendent, C. R. Faben, Jr.; Secretary, Thomas Biddell.

The new gasholder for the Exeter (N. H.) Gas Company, work on which is now underway, will be located on the river side of Newmarket road.

A few months ago the residents of Wheeling, W. Va., were told that a plant calculated to maintain 400 arcs would not only be sufficient for the city's actual lighting needs, but would permit of the keeping of one 80-light dynamo in reserve, to be started up in case of a breaking down of one of the machines in service. With that understanding the plans were carried out; but the actual test of service shows a woeful deficiency in the lighting results, for the residents are now informed that $10,000 more will have to be expended for the purchase of "another dynamo, lamps and other apparatus." Mr. George Heil, Secretary of the Board of Gas Trustees, has formally applied to the authorities for the "relief" specified, and we suppose the taxpayers will have to be satisfied to pay for the "hair as well as the hide."

The Cutter Gas Lighting Company has been incorporated at Chicago by Messrs. Henry H. Cutter, George Cutter and Albert C. Abbott. It is capitalized in $100,000.

A charter for a gas works has just been granted by the authorities of the town of Cicero, Cook county, Ills., to Mr. N. A. McClary and associates. Cicero, which adjoins Chicago on the west, is 6 miles in length (north to south), and averages 3 miles on the line from east to west. Seven of the principal railroads, entering Chicago from the west, cross Cicero, and the furthest point in the town, by numerous suburban trains, is only about 30 minutes from the Chicago city hall. Electric cars also connect with the cable cars on Madison street, and run across the town on Lake and Madison streets. All these facilities for rapid transit into Chicago are stimulating the rapid growth of the many villages and subdivisions on the various lines, and now there is an almost universal call for a gas supply. The works at Cicero will be con-

structed by the National Gas and Water Company, 218 La Salle street, Chicago, and gas will be turned on within one year.

It is said that the growth of the suburban districts of Chicago has caused some talk about placing a "belt line gas company" at an eligible point in the said suburban districts; but the proposition is only in the "talking stage" at present.

Messrs. Samuel F. Hodge & Co., of Detroit, Mich., have adopted the plans of the Berlin Iron Bridge Company, of East Berlin, Conn., for their new foundry, and have placed the contract with the Berlin Company for the construction of the building. It is promised that this will be the most perfect and best appointed foundry in the Northwest. The general dimensions of the building are 86 feet in width by 161 feet in length, with wings (23 feet in width) on both sides. The center of the building is controlled by a travelling crane, with a course the full length of the building. The wings are to be controlled by jib cranes, so that, when completed, every inch of the floor space will be controlled by power, either from the travelling crane or from jib cranes. The house proper will be constructed entirely of brick and iron.

The Bridgeport (Conn.) Gas Company is making important improvements on its main system, notably on Main street, preparatory to the carrying out of the order by the city authorities for the macadamizing of that thoroughfare.

The proprietors of the Denver (Col.) Consolidated Gas Company have entered into a contract with Captain W. H. White for the construction of an auxiliary water gas plant, of the improved Lowe double superheater type, under the control of the United Gas Improvement Company. The apparatus is to be housed in a brick building, to be 121 feet by 40 feet. The apparatus is to be in duplicate, and the connections are to be 16 inches in diameter. A relief holder, of a capacity of 100,000 cubic feet, to rest in a steel tank, is also to be installed. The main connections about the coal gas plant are to be enlarged to 20 inches, from 16 inches. The Company will also put down 10 miles of additional mains, of varying diameter, from 16 inches to 4 inches; and it is estimated that the several contracts noted will be completed by Nov. 1. The work will all be carried on under the immediate supervision of Mr. Wm. J. Fay, the Company's resident Consulting Engineer.

Major L. G. McCauley, Superintendent of the West Chester (Pa.) Gas Company, is making a determined effort this season to induce the residents to go in for cooking by gas, and with that end in view offers to supply gas for fuel purposes at the very low rate of $1 per 1,000 cubic feet. He advertises the fact largely in the local papers, and also says in those advertisements that gas stoves may be purchased at the office of the Company, as also at the Philadelphia office of the Gas Appliance Exchange. To tell the truth, we fail to see the advantage of referring West Chester's gas consumers to the Exchange, when the Company can do all that the Exchange can do, with the additional advantage to the Company of accomplishing the business at first hand. However, the Major knows best the practice that will advance his Company's interests, and in his hands it may be safely left, for he has managed its affairs with exceeding skill for many years.

In the meantime, it looks to not a few gas men that the Gas Appliance Exchange is about as necessary to the makers of gas apparatus, and to the gas industry in general, as a fifth wheel would be to a road wagon.

One of the best kept gas plants in New Jersey is that presided over by Superintendent Curtis, at Woodbury, N. J. The Company, which is known as the Consumers Gas Company, enjoys a very prosperous business.

We are indebted to a correspondent at Worcester, Mass., for the following text of the decision of the Massachusetts Board of Gas and Electric Light Commissioners, in the instance of certain petitions respecting a proposed increased supply of gas for New Bedford, the hearings about which were published in the Journal some time ago. The findings are:

"*Consumers Gas Company, of New Bedford, Appellant.*—These were appeals from the Mayor and Board of Aldermen and from the Board of Public Works of the city of New Bedford. The Consumers Gas Company, regularly organized under the laws of this Commonwealth, applied to the Mayor and Board of Aldermen of New Bedford for leave to open about 5 miles of the principal streets for the purpose of laying gas mains. That Board declined to grant the petition, on the ground that it did not have jurisdiction in the matter, and referred it to the Board of Public Works, which, after a public hearing, dismissed the petition. The Consumers Gas Company, assuming the action of the Board of Aldermen to be a refusal, appealed from the decision of both Boards. The hearings, which were held in New Bedford, occupied several days, and the city, the appellant, and the New Bedford Gas and Edison Light Company were represented by counsel. The latter Company has alone had the right to supply gas in New Bedford since 1853. In 1888 it began to supply electric light, having purchased the property and rights of the New Bedford Electric Light Company, and in July, 1890, it was consolidated with the Edison Electric Illuminating Company of New Bedford, under authority of a special act of the Legislature. Since that time it has been the only Company selling gas or electric light in that city. The consumers of the present Company were numerously represented among the witnesses, and were encouraged to describe as fully as possible their grievances. Their testimony showed a general satisfaction with the quality of the gas, but a considerable desire to secure it at a lower price, and much complaint about the administration of the electric department and the prices charged for the incandescent light. The petitioners claimed that if their requests should be granted they could supply a gas superior to that of the existing Company, and at a lower price. The shareholders in the petitioning Company were interested in the ownership of a patented process for making gas from oil, water and air, and it appeared from the evidence that it was their intention to use this particular process, if their request was granted. Upon this their case principally rested. The Board has endeavored to ascertain whether this process gave reasonable promise of fulfilling the expectations and intentions of the petitioners. Plans and the evidence of experts were submitted and carefully considered, and an examination of a plant in actual operation was made by the Board. The process does not differ essentially from that in common use in many small towns where oil gas is distributed, except in the introduction into the retort with the oil of a nearly equal amount of water, and in the mixing of the gas and air in the heated retort instead of in the holder. It was proposed also to filter the oil before using through a 'vegetable compound consisting of ground corn cobs and ashes from the wood and bark of the white ash tree,' and also to pass through the retort a certain amount of the aqueous extract of potatoes; but no explanation of the value of these to the gas was attempted, and no particular consideration given to it by any of the parties interested. A test of the apparatus and process was made under the supervision of the inventor, and in the presence of experts selected by the two Companies interested, and these agreed in their testimony before the Board in all material points. This test afforded a good illustration of the value of the process, as the experimental bench was of the full size for commercial use. Crude oil, coal, pine wood, potato extract, corncobs and ashes were used as directed, and gas was made at the rate of about 445 feet per hour. The result of the operation showed that to make 1,000 feet of this gas, in the holder ready for use, would require 9.12 gallons of crude oil, 81.3 pounds coal, one-sixth cord feet of wood, one pint potato extract, one-fifth bushel ground corn cobs and one-fifth wine pint wood ashes, costing in that locality about 70 cents. To these figures must be added labor, which may be fairly estimated at not less than 13 cents in a large works of this kind, making at least 83 cents for the cost in the holder. Although these figures include nothing for repairs or depreciation they much exceed the cost of manufacturing the gas of the Company now in operation. The specific gravity of the gas is .790, and that of the present Company's does not exceed .560, from which it appears that the proposed gas is about 40 per cent. heavier than that now used. To distribute the same amount of the former, unless at greatly increased pressure, would require larger mains, a larger investment, and, therefore, greater cost for distribution. It would also require interior pipes and fittings of larger capacity. Several tests of the candle power of the gas showed an average of 17.29, which is from .18 to 1.70 candles lower than the average of the present Company's gas. The analysis of the gas made by the experts referred to above showed the following results, the figures indicating the relative volumes of each constituent:

Carbonic acid	2.30
Illuminants	21.85
Oxygen	2.45
Carbonic oxide	6.90
Hydrogen	3.40
Marsh gas	13.61
Nitrogen	49.49

It will be seen from this that more than half of the entire volume consists of carbonic acid and nitrogen, gases which neither burn nor aid combustion, but seriously diminish the flame temperature of any gas of

which they form a part. The gas has, then, a low value for cooking or heating purposes, this peculiar composition and result being due to the large amount of air used in its manufacture. From these facts it appears that the gas of the process proposed is of lower candle power, of less heating capacity and more expensive to produce than that now used in New Bedford. The petitioners stated, however, that if they found after trial that this gas was for any reason unsatisfactory, as to quality or cost, they should abandon its use and should adopt some process which would produce the best possible quality at the lowest possible cost. Had they been able to make this offer more definite, it would have deserved more extended consideration; no other process was, however, mentioned or alluded to. For these reasons the Board is unable to see that any advantage can come to the citizens or gas consumers of New Bedford by granting the prayer of the petitioners, which may not be readily secured from the present Company. A strong and general feeling of hostility to the Company and certain peculiarities of administration was a prominent feature of the hearing. The Board regrets exceedingly that any foundation for this exists in fact. Very much of this sentiment is doubtless due to changes inevitable upon a consolidation of these Companies, but more to the methods pursued in dealing with consumers, as illustrated in the manner of advancing the electric rates to a living basis, and in the arbitrary and monopolistic spirit pervading the printed regulations or rules issued by the Company. The present Company has, it is true, a practical monopoly of the lighting business, but the extensive privileges and concessions which it has received as a free gift from the public impose upon its managers an imperative duty to conduct its affairs in the same spirit and with the same effort towards the public convenience as the successful merchant employs to attract and retain his trade. In considering this case no attempt has been made to pass upon the absolute value of the particular process considered, but only its relative value in the locality considered. Neither is an opinion expressed as to the fairness of the price charged by the present Company for its gas; such question is not necessarily within the scope of the present inquiry, nor could any order affecting it be based upon these proceedings. The Board, however, notes with approval the fact that the Company has voluntarily reduced the price of gas since the hearing upon this appeal was begun. Most of the complaints by the witnesses were either of the quality or the price of the electric light. The Board has taken no formal action in reference to these for the reason cited above. It has, however, made a careful examination of both of the electric plants, has studied their management and conferred with the Company concerning them. As a result of this it has received satisfactory assurance that all the changes needed to secure the best possible electric service will be made and that the Company will soon make a considerable outlay in this department. Upon a careful review of the whole case the Board is of the opinion that the appeal cannot be sustained; and it is therefore, ordered, that the appeal of the Consumer's Gas Company be dismissed and the decision of the Board of Public Works be affirmed. The same reasons supply ample ground for a refusal to sustain the appeal from the Board of Aldermen, and it seems unnecessary to rule upon or discuss the legal questions raised as to the relations of that Board to the petition or to the Board of Public Works. Both appeals are dismissed.—For the Board, JEREMIAH W. CONVENEY, Chairman."

ANOTHER evidence of the closer business ties that are being drawn constantly between the United States and Canada is given in the shape of a contract recently awarded to Messrs. J. H. Gautier & Co., of Jersey City, N. J., by the Consumers Gas Company, of Toronto, under which the former will put up 20 benches of 6's, to be fired by means of the Flemming furnace, in the new plant to be erected by the Company under the advice and overlooking of Manager Pearson.

THE City Council of Findlay, O., has instructed the Gas Trustees, who are in charge of the municipal gas (natural) plant, to overhaul the main system, which it is claimed is deficient in many particulars.

CALLS have been made by the Montreal (Canada) Gas Company on account of subscriptions to new issue of stock.

A CORRESPONDENT at Boston, Mass., under date of the 8th inst., writes as follows: "Mr. F. M. Stimson, who died at his home in Cambridge, on Monday morning, was well known to the business community of Boston. He was born in Cambridge in 1814, and at the age of 18 graduated from the Classical School, in the same class with Higginson, Holmes and Lowell, but did not enter college with his associates. For many years he resided in Nashua and held important offices at that place, and in Cambridge he was Chief of Police for 12 years. He was a Director in the Cambridge Gas Light Company, and at the time of his death was a Director of the Charles River Bank. He was a man of unusual business and financiering ability, and combined with his thrift honesty and uprightness of character."

MR. ADAM EHEBOLD, of this city, as was noted some weeks ago in the JOURNAL, has patented an improvement in the construction of gas meters, relating chiefly to the stuffing boxes thereof, which seems to us to be of sufficient importance to warrant some explanation of the device. It might be said that the improvements also include a simple method of fastening the slide valve wrist key. Heretofore a marked drawback in the stuffing boxes has been the tendency to leakage, which, apart from other things, leads to danger of explosion, and damages other working parts of the meter, when such leakage enters its upper chamber. The Ehebold stuffing box is designed to do away with these tendencies; also, to secure a more thoroughly accurate measurement of the gas. The illustrations given can easily be comprehended, when taken in connection with the letter references of the description.

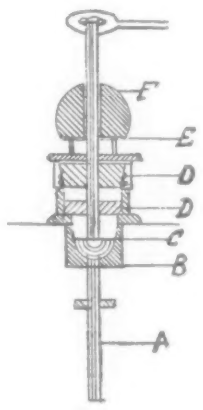


Fig. 1.

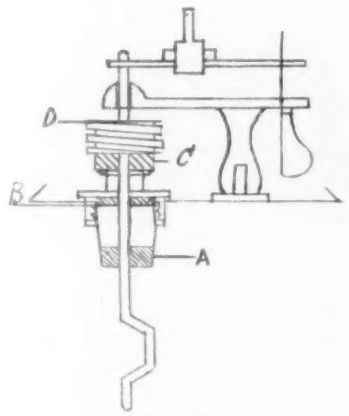


Fig. 2.

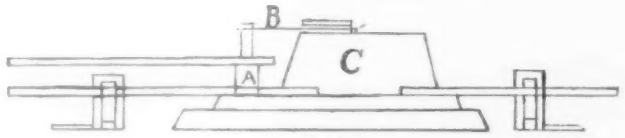


Fig. 3.

Fig. 1 is an elevation of the side stuffing box, with packing. *A* shows a flag wire; *B*, the stuffing box, with cap screwed to the outside; *C* shows a hard metal bearing bulb, which travels very easily in a cup shaped seat, designed to prevent gas from getting into the stuffing box, and so constructed as to prevent injury to the meter through falls or jars. *D*, *D*, show cork washers, prepared in such a manner that they always remain elastic and gas tight. The empty space between the washers is for packing. *E* is a flexible washer, which, fitting tightly around the flag wire, rests on the cap; *F* is a weight, bearing on the washer *E*, keeping it in its place. Fig. 2 shows crank, or center stuffing box, in working order. *A* is the cork washer in the bottom of the stuffing box, which is stationary—the empty space is for packing; *B* shows the cork washer on the top of the packing; *C* shows a flexible washer which fits close around the crank and rests on the neck of the cap; *D* is the regular worm, acting as a weight on the flexible washer, and travels on top of said washer. Fig. 3 shows a slide valve with improved wrist key, in which *A* is the valve arm wrist; *B* is an improved key, which is removably seated into the wrist, *A*, and secured to the slide valve, *C*. This key can readily be removed without injuring the valve wrist. The address of the inventor is No. 321 West 25th street, New York.

THOMAS A. HINES, a laborer formerly in the employ of the Georgetown (D. C.) Gas Light Company, has instituted a suit for damages against that corporation, complainant putting his damages at $20,000. According to the papers served Hines claims that, while working in a ditch on N street, on December 5th, 1891, he was overpowered by the escape of gas from a pipe that he was repairing, and inhaled sufficient gas to make him unconscious. He claims that his injuries are permanent, and adds that there was an understanding at the works that the gas should be turned off from that particular pipe, and that the neglect to do this caused his injuries. The Company pleads contributory negligence.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

MONDAY, JUNE 20, 1892.

The Market for Gas Securities.

Contrary to the usual course of gas shares in this vicinity in the summer months, when dealers in such securities are accustomed to accept as natural a very stagnant market, we this year are treated to a lively (if not rampant) and pronounced bull market. Consolidated, it is true, goes along in the even tenor of its way, but there is no denying the fact that even this specialty acts as though it might jump to 120 at any day—a figure we have no doubt it will make before next dividend time. Equitable is fairly booming along, and we doubt if 500 shares could be secured without sending the quotation to 160. Mutual is also strong, and even Standard reflects the current strength, 10 shares of the preferred having been taken at auction this week, at 90½. In the meantime the East River Company's manipulators have been "opening bids" for the construction of a "tunnel or tunnels" under the river, and also "are prepared to make contracts for plant construction with responsible contractors." Judging from this it will soon be time for the appearance on the street of stocks and bonds connected with the development of the plans of the financier whose home is in two continents.

In Brooklyn the market is stronger than for years back. In fact, the shares in one or two Companies are selling at prices far in excess of their intrinsic value. For instance, Metropolitan readily commands 115, but before that Company is in position to properly supply its district the main system will virtually have to be reconstructed, which means, as every engineer knows, a very large expenditure of money. As was said in the JOURNAL of a fortnight ago, Mr. Addicks has secured control of the old Brooklyn Company, and now, that he has it, what will he do with it? The Equity Company had not, up to yesterday (Thursday), yielded to his blandishments. In short, the best way for holders over in Brooklyn just now is to take the high prices ruling, for there is no doubt that a little later on the shares can be taken in at a smart decline. Chicago gas is strong, and Baltimore Consolidated is at 55¼ to 55½. The decision of Judge Conrad, in the contested gas ordinance case at Des Moines, Ia., ought to exert a very beneficial influence on the stability of gas shares in that State. The Equitable Company, of Memphis, Tenn., has declared a quarterly dividend of 1 per cent.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

JUNE 20.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	114¼	114½
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	153	155
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	135	138
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	40	45
Preferred	5,000,000	100	91	93
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	140
Citizens	1,200,000	20	113¼	113½
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	—	140
" Bonds	300,000		102	—
Peoples	1,000,000	10	—	92½
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	—	120
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	145	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	—	130
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	90	90¾
2d " " "	3,000,000	1000	77	78
Bay State Gas Co.—				
Stock	5,000,000	50	60¼	60½
Income Bonds	2,000,000	1000	6	8
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	81⅜	81½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	90½	90⅞
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	97½
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	102	—
2d "	2,500,000	1000	101½	—
Consumers Gas Light Co., Jersey City	2,000,000	100	20	—
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	7,000,000	100	—	200
Consumers Toronto	1,000,000	50	180	185
Central, S. F., Cal.			90	—
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	55	55¼
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	180	200
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	20	20½
Preferred "	2,500,000	100	61⅓	62
Bonds	9,034,400	1000	83½	84
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	40	—
" Bonds.	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			34¾	35¼
Peoples, Jersey City		—	115	125
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	99	100
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	63	63½
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	88	90

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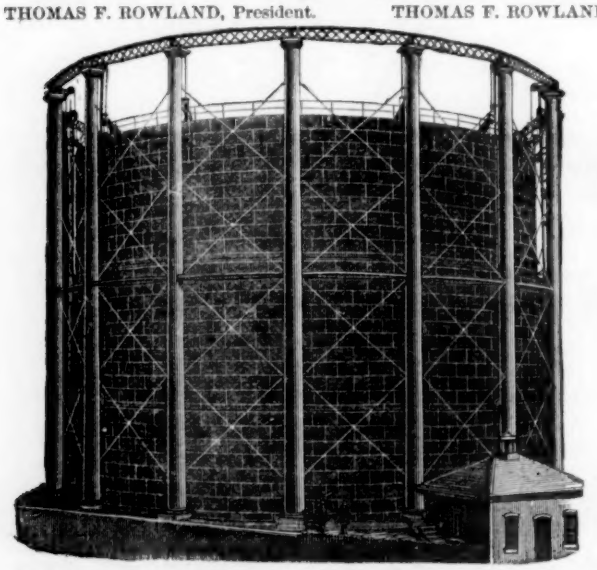

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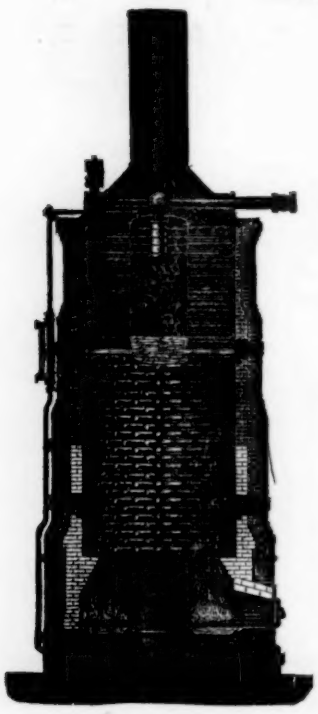

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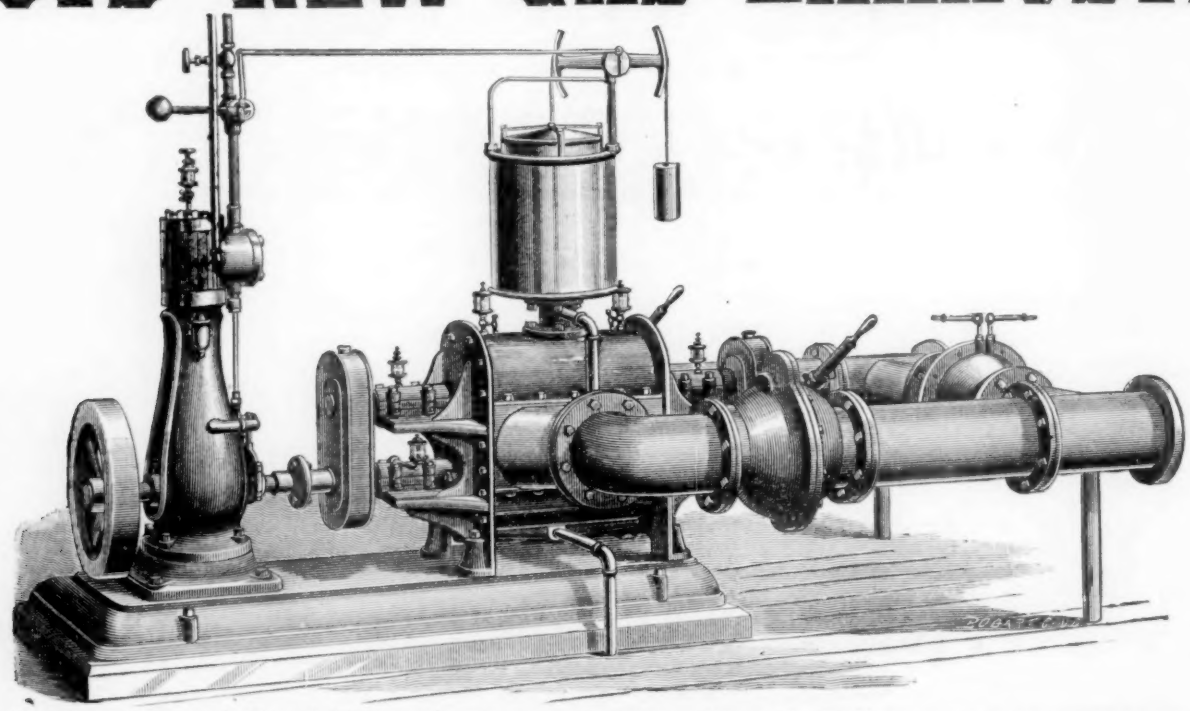

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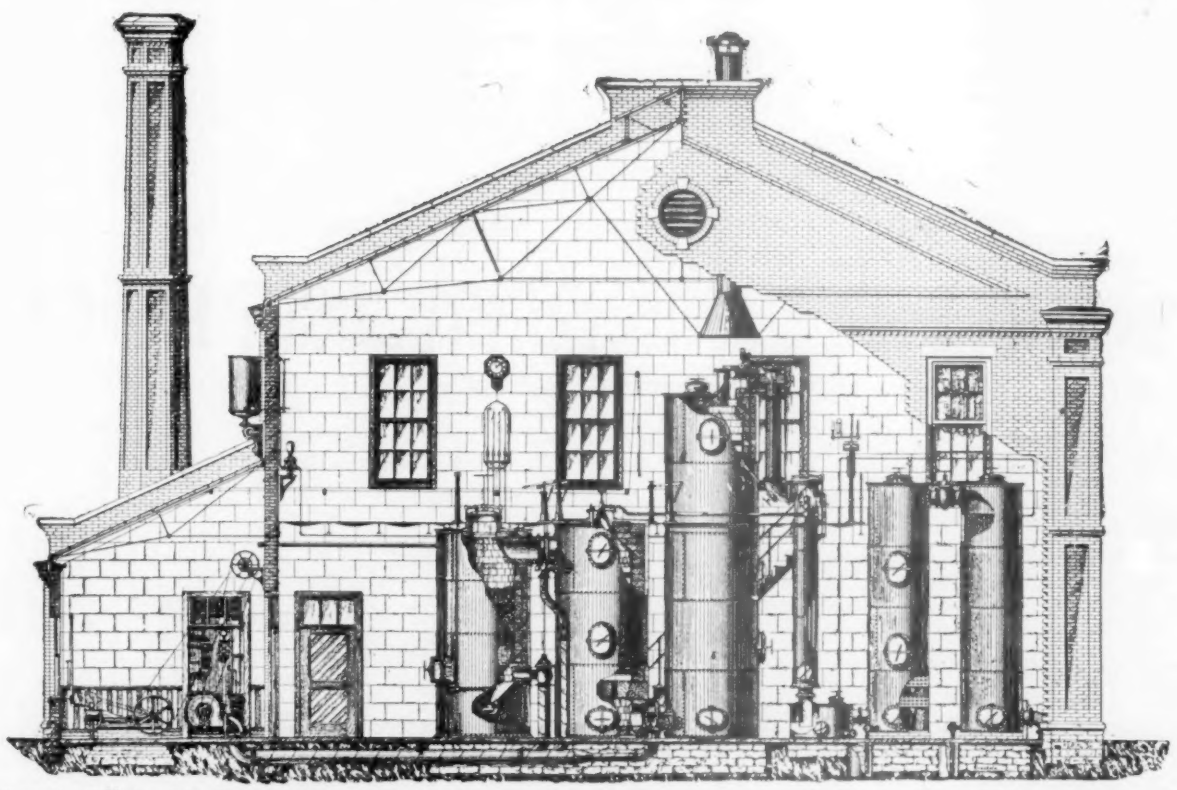

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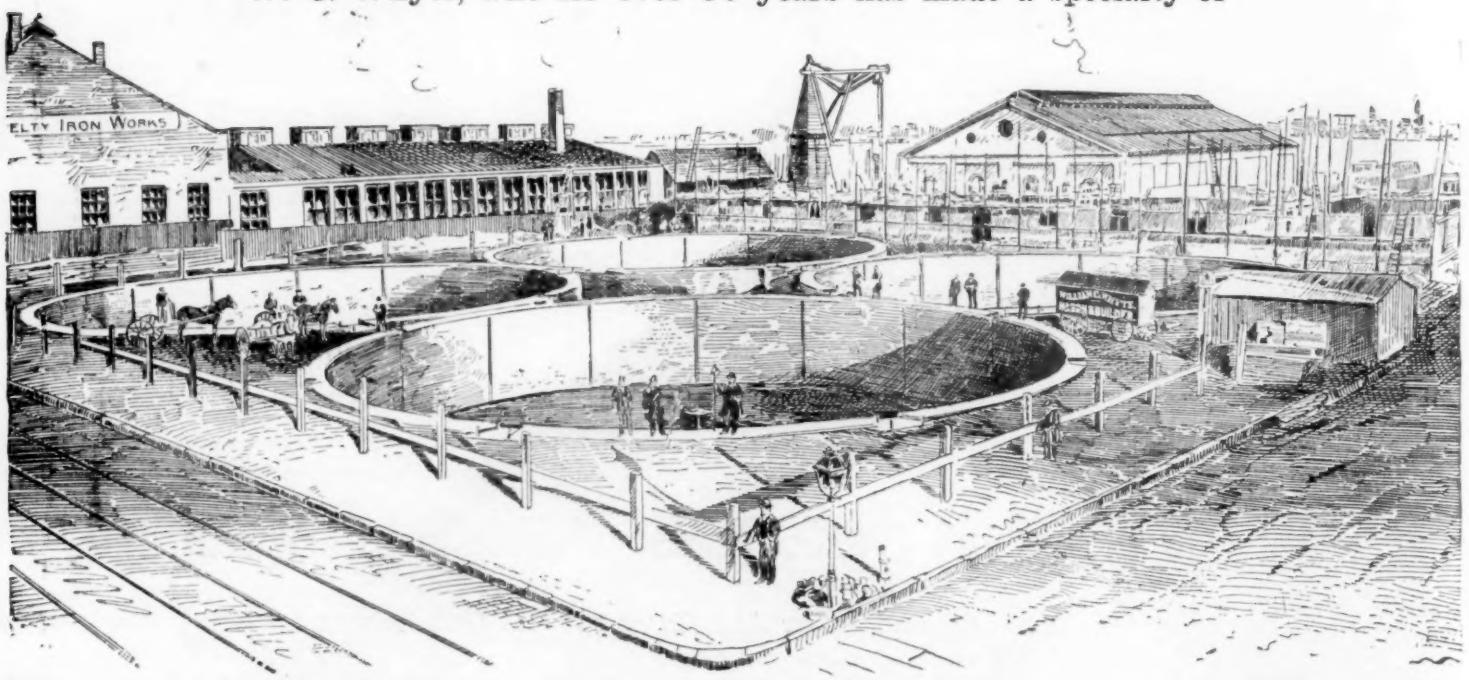

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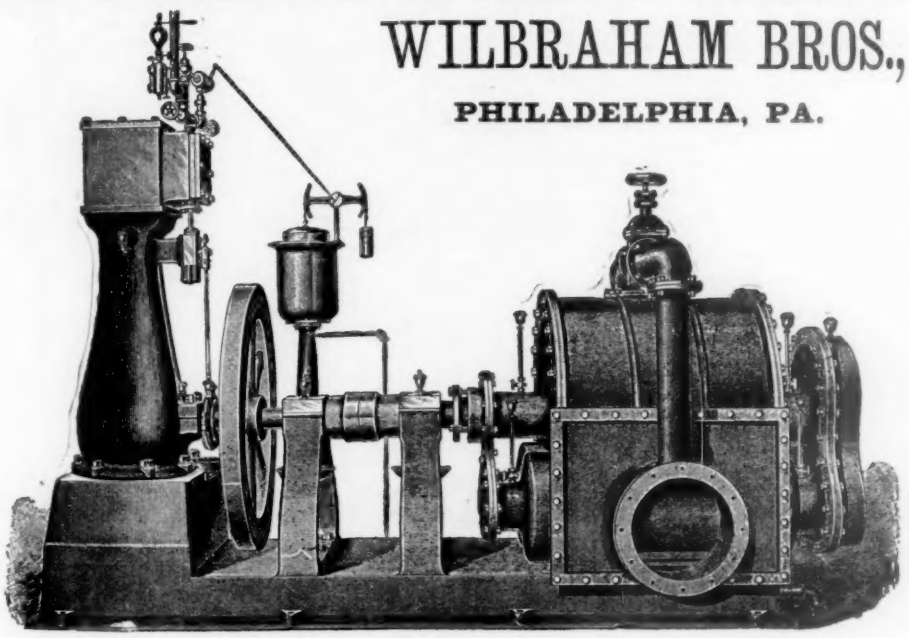

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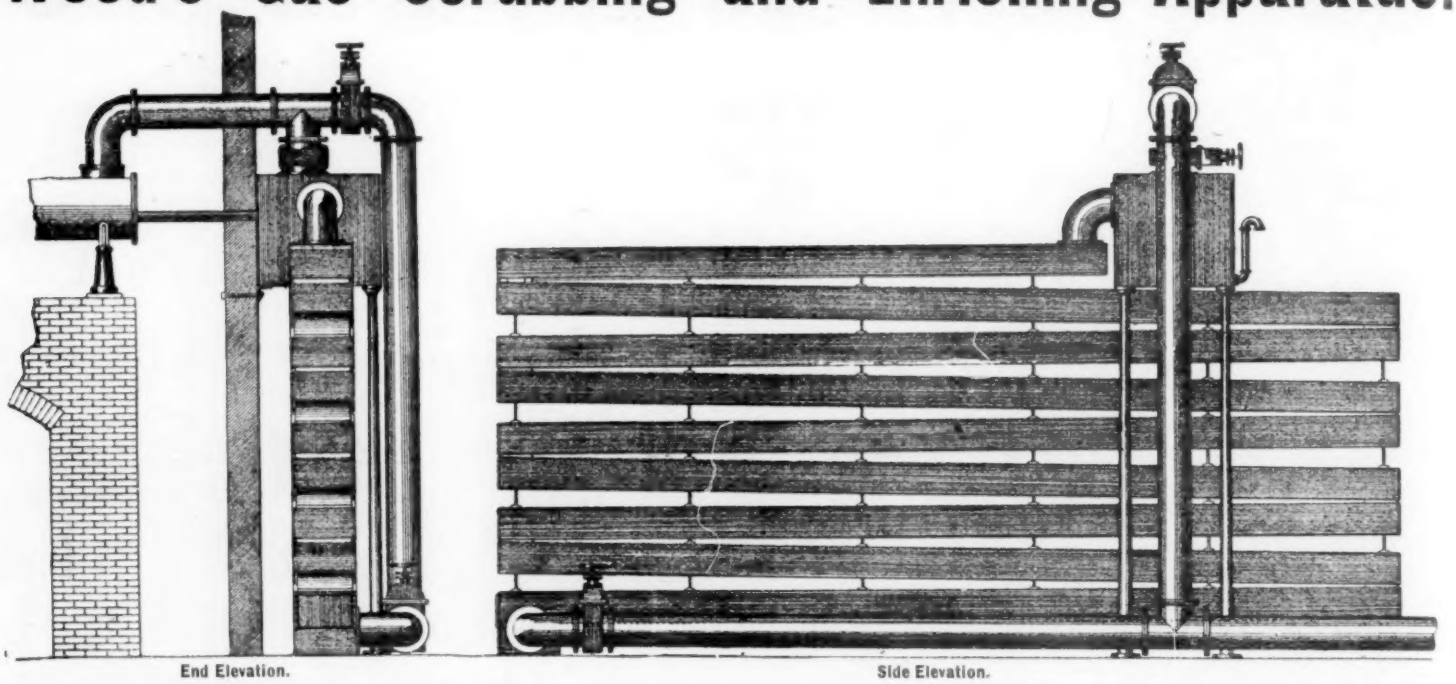

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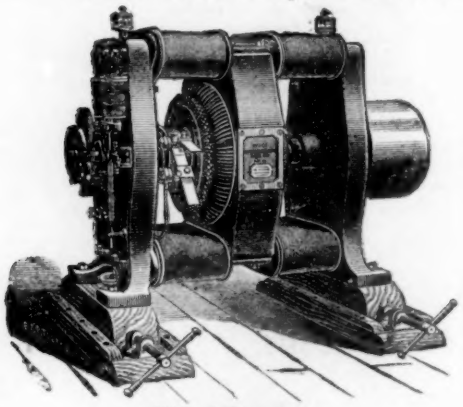

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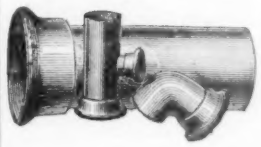

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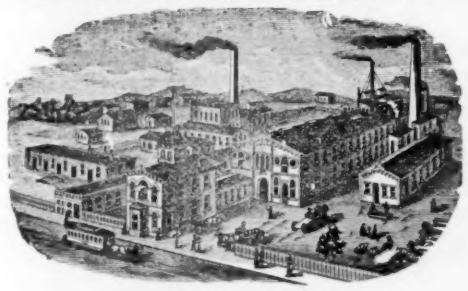

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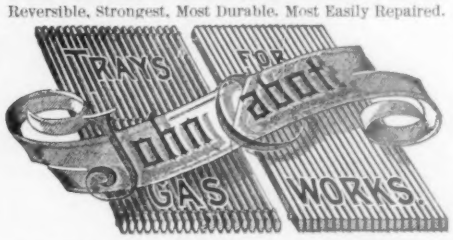

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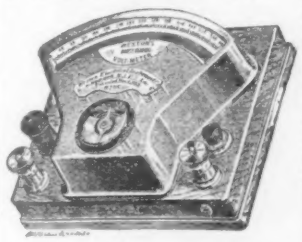

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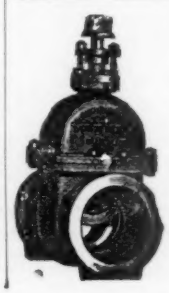

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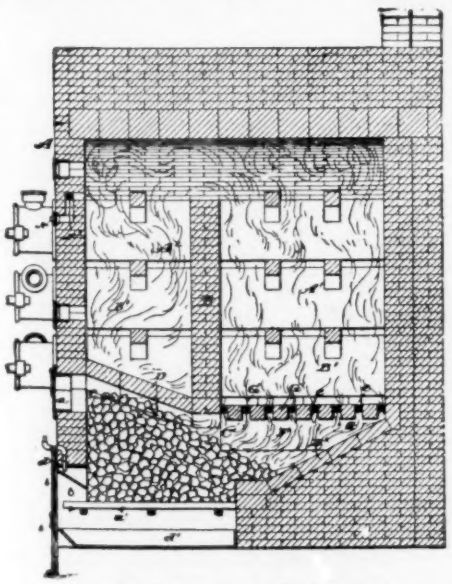

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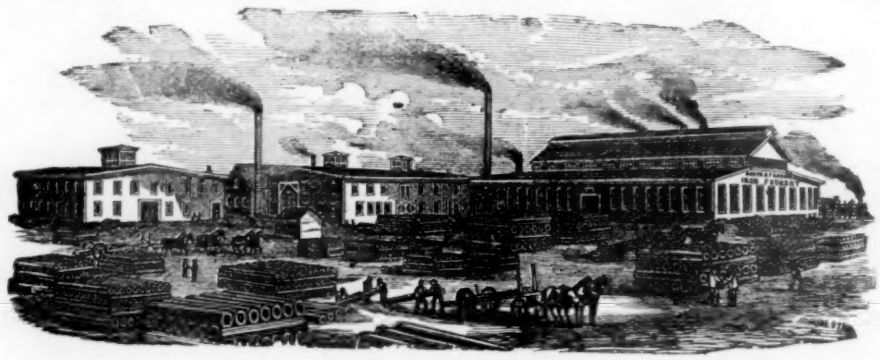

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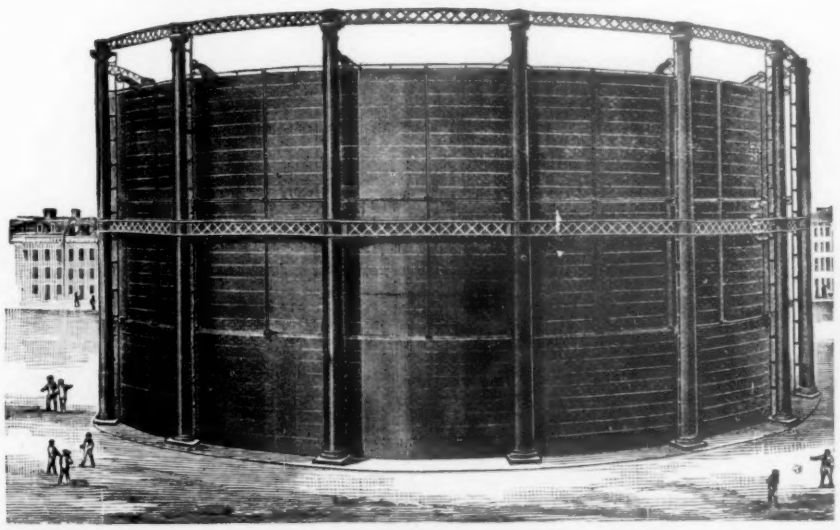

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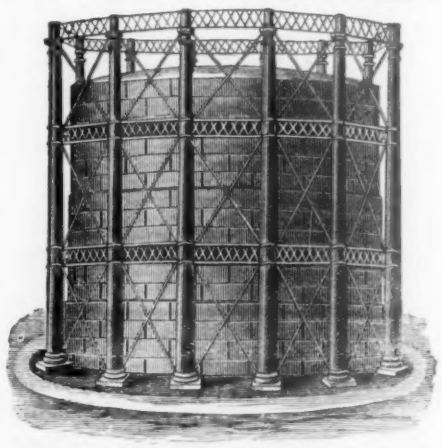

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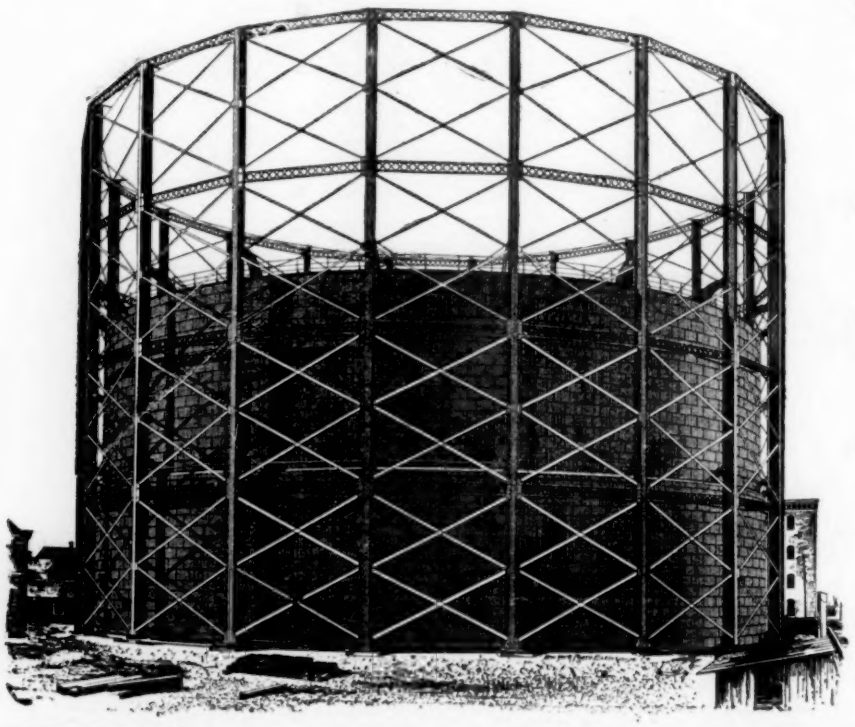

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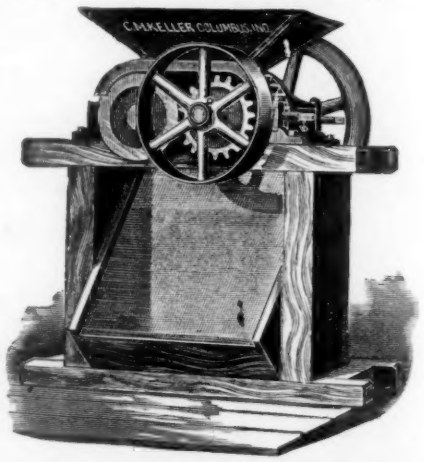

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